SCHOOL OF ENGINEERING

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Undergraduate Degree Courses in Engineering & Technology

Department of Chemical Engineering

(1) Vision: To contribute towards service and development of the mankind, through quality education and research in the area of Science, Technology and Management.

(2) Mission: To create quality manpower equipped with technical skills, social values, leadership, creativity, and innovation for the benefits, betterment of mankind and sustainable development of the nation.

(3) Program Educational Preambles (PEO's):

PEO 1: To prepare students for advanced studies in Chemical Engineering and its allied fields.

PEO 2: To prepare students for successful practice in the fields of chemical engineering such as pharmaceuticals, chemicals, polymers / advanced materials, energy, biotechnology, and environmental engineering and in the fields of societal expectations on time.

PEO 3: To develop students' skills and awareness to become socially, ethically and morally responsible individual in all the challenges they take over in our communities and in the field of chemical engineering.

(4) Programme Outcomes (PO's):

PO-01: Engineering Knowledge: Students will have an ability to apply knowledge of mathematics, science, and engineering to chemical engineering problems.

PO-02: Problem Analysis: Ability to command chemical engineering fundamentals such as mass and energy balances, chemical thermodynamics, fluid dynamics, solid and fluid transport, mass and energy transport, chemical kinetics and integrate into a functional chemical process along with instrumentation and process control.

PO-03: Design/Development of Solution: 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.

PO-04: 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.

PO-05: Modern Tool Usage: Apply knowledge of chemical engineering to identify, formulate & solve recent industrial problems using modern engineering tools. Ability to develop proficiency in applying modern computational tools such as ASPEN, MATLAB, ANSYS for successful modeling and simulation.

PO-06: The Chemical engineer and society: Apply reasoning informed by the contextual knowledge of chemical engineering to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to chemical engineering practice.

PO-07: Environment and Sustainability: Ability to design equipments and processes in the field of chemical engineering considering the economic efficiency, safety, ethics and environmental responsibilities.

PO-08: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the chemical engineering practices.

PO-09: Individual and Team Work: Function effectively as a chemical engineering professional, individual and member or leader in diverse technical teams related to area of chemical engineering.

PO-10: Communication: Communicate effectively on complex engineering activities specifically chemical engineering related 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.

PO-11: Project management and finance: Demonstrate knowledge and understanding of the chemical 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.

PO-12: Life-Long Learning: Ability to carry out interdisciplinary research and engage in life-long learning process in the fields of environmental engineering, nano-science and technology, bio-energy, biochemical engineering, pharmaceutical engineering, material engineering.

(5) Program Specific Outcomes (PSOs)

PSO-1 Automate and control processes by applying mathematics, process control, instrumentation, simulation and process modeling.

PSO-2 Create successful Chemical Engineering graduates to understand the basic concepts of the Chemical Engineering and to apply them to various core and allied areas like petrochemical technology and environmental management etc.

(06) Programme PO's and PSO's Mapping

			PO 1	PO2	PO 3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO1 2		
S. No	**Program**	**Courses Category**	Engineering Knowledge	Problem Analysis	Design/ Development of Solution	Conduct investigations of complex problems	Moder n Tool Usage	The Chemical engineer and society:	Environment and Sustainability	Ethics	Individual and Team Work	Communication	Project management and finance	Life - Long Learning	**PSO 1**	**PSO 2**
1	BE(CM)	Humanities and Social Sciences including Management courses	*	*			*	*		*		*		*		
2		Basic Science courses	*	*	*	*	*		*							
3		Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	*	*	*		*							*		
4		Professional core courses	*	*	*	*										
5		Professional Elective courses relevant to chosen specialization/branch	*	*	*	*	*	*		*	*					
6		Open subjects – Electives from other technical and /or emerging *subjects	*	*	*	*	*	*	*	*	*			*	*	*
7		Project work, seminar and internship in industry or elsewhere		*	*	*		*	*	*	*	*	*	*		*
8		Specific core subject		*	*	*										
9		Mandatory Course (Non credit)						*	*	*	*	*		*		

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(07) Semester Wise PO's and SPO's Mapping

Semester	Name of the Courses/POs(Basic, Core Electives, Projects, Internships etc.)	PO 1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO12	PSO 1	PSO 2
		Engineering Knowledge	Problem Analysis	Design/Development of Solution	Investigation	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Team Work	Communication	Project Management	Life-Long Learning		
Semester-Ist	Mathematics-I	*	*	*	*								*		
	Engineering Physics	*	*		*								*		
	Basic Computer Engineering	*	*	*	*	*			*		*		*		
	Basic Mechanical Engineering	*	*	*	*	*									
	Basic Civil Engineering & Mechanics	*	*	*				*						*	
	Language Lab					*			*	*	*		*		
	Self Study / GD Seminar	*	*	*	*	*			*	*		*	*		
Semester-IInd	Mathematics-II	*	*	*	*								*		
	Engineering Chemistry	*	*	*	*										
	English for Communication	*									*			*	
	Basic Electrical & Electronics Engineering	*	*	*	*										
	Engineering Graphics	*	*	*	*										*
	Manufacturing Practices					*			*	*	*	*	*		
	Industrial Training			*	*		*	*	*	*		*	*	*	
Semester-IIIrd	Mathematics -III	*	*	*	*										
	Chemical Engineering Thermodynamics	*		*	*				*	*			*		
	Advance Engineering Chemistry	*		*			*						*		
	Material & Energy Balance	*		*		*						*			
	Chemical Instrumentation	*	*			*		*		*					
	Computer Programming-I	*	*	*	*	*									
	Self study /GD Seminar		*	*		*	*	*	*		*	*	*		
Semester-IVth	Energy, Ecology, Environment & Society						*	*		*				*	
	Fluid Particle Mechanics	*		*	*	*			*						
	Fluid Mechanics	*	*	*	*	*		*							
	Fuel Technology	*	*	*	*	*	*								*

	Inorganic Process Technology	*						*							
	Computer Programming-II			*	*	*							*		
	Industrial Training-I		*	*		*	*	*	*	*		*	*		
Semester-Vth	Heat Transfer	*	*		*	*									
	Mass Transfer-I	*	*	*	*										
	Chemical Reaction Engineering-I	*	*	*	*										
	Organic Process Technology	*						*							
	Oil & Paint Technology		*			*		*	*						
	Petroleum Processing Technology		*	*			*								
	Conventional & Non-Conventional Energy Sources		*	*	*			*							
	Industrial Training-II		*	*	*	*	*	*	*	*		*	*		
Semester-VIth	Mass Transfer-II	*	*	*	*	*	*								
	Chemical Reaction Engineering-II	*	*	*	*										
	Transport Phenomena	*			*	*									
	Bio Chemical Engineering			*	*	*									
	Environmental Pollution & Pollution Control			*				*	*		*				
	Fertilizer Technology		*	*	*	*									
	Nano Technology in Catalysis				*	*	*			*					
	Fluidization Engineering		*		*	*									
	Minor Project		*	*	*	*	*	*	*	*		*	*		
Semester VIIth	Process Control	*		*	*	*			*						
	Numerical Method in Chemical Engineering	*		*	*	*	*								
	Polymer Technology	*	*	*			*								
	Multi-Phase Flow	*			*										
	Food Technology	*		*											

	Optimization Methods			*			*			*					
	Project Stage-I		*	*	*	*	*	*	*	*		*	*		
	Self Study/GD/Seminar		*	*	*	*	*	*	*	*		*	*		
Semester VIIIth	Chemical Process Modeling and Simulation	*			*	*									
	Chemical Process Equipment Design		*			*	*	*	*						
	Novel Separation Technology	*		*	*	*									
	Safety and Risk Analysis		*	*			*	*							
	Petrochemical Technology						*	*	*	*	*	*	*		
	Project Stage-II		*	*	*	*	*	*	*	*		*	*		
I/III/IV (prefered Semester)	Mandatory Courses							*	*	*	*	*	*		

(08) <u>Structure of Programme</u>: To fulfill the need of development of all the POs/ GAs, as per above mapping, the following semester wise programme structure are as under.

<u>[L= Lecture, T = Tutorials, P = Practical's & C = Credits]</u>

Total Credits*= 160

Structure of Undergraduate Engineering program:

S. No.	Course Category	Credits of the CM Curriculum
1.	Humanities and Social Sciences including Management	11
2.	Basic Sciences	24
3.	Engineering Sciences including workshop, drawing, basics of electrical/mechanical/computer etc.	19
4.	Professional Core Subjects	52
5.	Professional Subjects: Subjects relevant to chosen specialization/branch	18
6.	Open Subjects: Electives from other technical and/or emerging subjects	18
7.	Project work, seminar and internship in industry or elsewhere	18
8.	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition]	Non-credit
	Total	**160**

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***Definition of Credit:**

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (Lab)/week	1 Credit

(09) Scheme of Exanimation (Chemical Engineering) Academic Year 2019-20

I Semester

S. No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	BEBSC-101	Mathematics-I	60	30	10	-	-	100	3		-	3
2	BEBSC- 202	Engineering Physics	60	30	10	30	20	150	2	1	2	4
3	BEESC-203	Basic Computer Engineering	60	30	10	30	20	150	3	-	2	4
4	BEESC-204	Basic Mechanical Engineering	60	30	10	30	20	150	2	-	2	3
5	BEESC-205	Basic Civil Engineering & Mechanics	60	30	10	30	20	150	3	-	2	4
6	BEHSMC-206	Language Lab	-	-	-	30	10	40	-	-	2	1
7	BELC-107	Self Study / GD Seminar					10	10			2	1
		Total	**300**	**150**	**50**	**150**	**100**	**750**	**13**	**1**	**12**	**20**

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II Semester

S. No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	BEBSC-201	Mathematics-II	60	30	10	-	-	100	3		-	3
2	BEBSC-102	Engineering Chemistry	60	30	10	30	20	150	3		2	4
3	BEHSMC-103	English for Communication	60	30	10	30	20	150	3	-	2	4
4	BEESC-104	Basic Electrical Engineering	60	30	10	30	20	150	2	-	2	3
5	BEESC-105	Engineering Graphics	60	30	10	30	20	150	2	1	2	4
6	BEESC-106	Manufacturing Practices	-	-	-	30	10	40	-	-	2	1
7	BELC-207	Industrial Training					10	**10**	**-**	**-**	**2**	**1**
		Total	**300**	**150**	**50**	**150**	**100**	**750**	**13**	**1**	**12**	**20**

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III SEMESTER

S. No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/ Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	BEA-301	Mathematics -III	60	30	10	-	-	100	3	-	-	3
2	CMA-302	Chemical Engineering Thermodynamics	60	30	10	-	-	100	2	1	-	3
3	CMA-303	Advance Engineering Chemistry	60	30	10	30	20	150	3	-	2	4
4	CMA-304	Material & Energy Balance	60	30	10	30	20	150	2	1	2	4
5	CMA-305	Chemical Instrumentation	60	30	10	30	20	150	3	-	2	4
6	CMA-306	Computer Programming-I	-	-	-	30	20	50	-	-	2	1
7	CMA-307	Self Study /GD Seminar	-	-	-	-	50	50	-	-	2	1
TOTAL			**300**	**150**	**50**	**120**	**130**	**750**	**13**	**2**	**10**	**20**

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IV SEMESTER

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments /Quiz	End Sem. Practical & Viva	Practical Record /Assignment / Quiz / Presentation		L	T	P	
1	BEA-401	Energy, Ecology, Environment & Society	60	30	10	-	-	100	2	1	-	3
2	CMA-402	Fluid Particle Mechanics	60	30	10	30	20	150	2	1	2	4
3	CMA-403	Fluid Mechanics	60	30	10	30	20	150	3		2	4
4	CMA-404	Fuel Technology	60	30	10	30	20	150	3	-	2	4
5	CMA-405	Inorganic Process Technology	60	30	10	30	20	150	3	-	2	4
6	CMA-406	Computer Programming-II	-	-	-	30	20	50	-	-	2	1
7	CMA-407	Industrial Training-I	To be completed during fourth semester break. Its evaluation/credit to be added in fifth semester									
	TOTAL		**300**	**150**	**50**	**150**	**100**	**750**	**13**	**2**	**10**	**20**

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V SEMESTER

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment / Quiz / Presentation		L	T	P	
1	CMA-501	Heat Transfer	60	30	10	30	20	150	2	1	2	4
2	CMA-502	Mass Transfer-I	60	30	10	30	20	150	2	1	2	4
3	CMA-503	Chemical Reaction Engineering-I	60	30	10	30	20	150	2	1	2	4
4	CMA-504	Program Elective-I	60	30	10	-	-	100	3	1	0	4
5	CMA-505	Open Core Elective - I	60	30	10	-	-	100	3	1	0	4
6	CMA-506	Industrial Training-II	-	-	-	150	100	250	-	-	4	2
	TOTAL		**300**	**150**	**50**	**240**	**160**	**900**	**12**	**5**	**10**	**22**

CMA-504, Program Elective-I	
CMA-504 (A)	Organic Process Technology
CMA-504 (B)	Oil & Paint Technology

CMA-505, Open Core Elective - I	
CMA-505 (A)	Petroleum Processing Technology
CMA-505 (B)	Conventional & Non-Conventional Energy Sources

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VI SEMESTER

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/ Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	CMA-601	Mass Transfer-II	60	30	10	30	20	150	2	1	2	4
2	CMA-602	Chemical Reaction Engineering-II	60	30	10	30	20	150	2	1	2	4
3	CMA-603	Program Elective-II	60	30	10	-	-	100	3	1	0	4
4	CMA-604	Program Elective-III	60	30	10	-	-	100	3	0	0	3
5	CMA-605	Open Core Elective - II	60	30	10	-	-	100	3	0	0	3
6	CMA-606	Minor Project	-	-	-	180	120	300	-	-	4	2
	TOTAL		**300**	**150**	**50**	**240**	**160**	**900**	**13**	**3**	**8**	**20**

CMA-603, Program Elective-II	
CMA-603 (A)	Transport Phenomena
CMA-603 (B)	Bio Chemical Engineering

CMA-604, Program Elective-III	
CMA-604 (A)	Environmental Pollution & Pollution Control
CMA-604 (B)	Fertilizer Technology

CMA-605, Open Core Elective - II	
CMA-605 (A)	Nano Technology in Catalysis
CMA-605 (B)	Fluidization Engineering

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VII SEMESTER

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	CMA-701	Process Control	60	30	10	30	20	150	3	0	2	4
2	CMA-702	Numerical Method in Chemical Engineering	60	30	10	30	20	150	3	0	2	4
3	CMA-703	Program Elective-IV	60	30	10	-	-	100	3	0	0	3
4	CMA-704	Open Core Elective - III	60	30	10	-	-	100	3	0	0	3
5	CMA-705	Project Stage-I	-	-	-	120	80	200	-	-	10	5
6	CMA-706	Self Study/GD/Seminar	-	-	-	-	200	200	-	-	2	1
	TOTAL		**240**	**120**	**40**	**180**	**320**	**900**	**12**	**0**	**16**	**20**

CMA-703, Program Elective-IV	
CMA-703 (A)	Polymer Technology
CMA-703 (B)	Multi-Phase Flow

CMA-704, Open Core Elective - III	
CMA-704 (A)	Food Technology
CMA-704 (B)	Optimization Methods

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VIII SEMESTER

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/ Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	CMA-801	Chemical Process Modeling and Simulation	60	30	10	30	20	150	3	0	2	4
2	CMA-802	Program Elective-V	60	30	10	-	-	100	3	0	0	3
3	CMA-803	Open Core Elective - IV	60	30	10	-	-	100	3	0	0	3
4	CMA-804	Project Stage-II	-	-	-	240	160	400	-	-	16	8
	TOTAL		**180**	**90**	**30**	**270**	**180**	**750**	**9**	**0**	**18**	**18**

CMA-802, Program Elective-V	
CMA-802 (A)	Chemical Process Equipment Design
CMA-802 (B)	Novel Separation Technology

CMA-803, Open Core Elective - IV	
CMA-803 (A)	Safety and Risk Analysis
CMA-803 (B)	Petrochemical Technology

***** Additional open electives can be provided as per the availability of faculty in the University and student should produce prior permission from Dean with a batch of at least 5 students.

(10) Course Content

Semester- I

BEBSC-101 Mathematics-I

BEBSC-101	**Mathematics-I**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preamble:-

The Preamble of this foundational course is to review mathematical concepts already learnt in higher secondary. This course will also introduce fundamentals of mathematical functions, derivatives and aspects of calculus to students. This course deep understanding of matrix, differential equations, Sequences and series, Vector Space as well as a strong sense of how useful the subject can be in other disciplines of learning.

Outcome:-

Course work is designed to provide students the opportunity to learn key concepts of mathematical functions, key concepts of matrix , Vector Spaces as well as fundamentals and applications of integral calculus.

Unit-I Calculus (10Hrs):

Rolle's theorem, Mean Value theorems, Expansion of functions by Mc. Laurin's and Taylor's for one variable; Taylor's theorem for function of two variables, Partial Differentiation, Maxima & Minima (two variables), Method of Lagrange's Multipliers.

Unit-II Integral (6 Hrs):

Definite Integral as a limit of a sum and Its application in summation of series; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas, Multiple Integral, Change the order of the integration, Applications of multiple integral for calculating area and volumes of the curves.

Unit-III Sequences and series (6 Hrs):

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Unit-IV Vector Spaces (6 Hrs):

Vector Space,Vector Sub Space, Linear Combination of Vectors, Linearly Dependent, Linearly Independent, Basis of a Vector Space,Linear Transformations.

Unit-V Matrices (10 Hrs):

Rank of a Matrix, Solution of Simultaneous Linear Equations by Elementary Transformation, Consistency of Equation, Eigen Values and Eigen Vectors, Diagonalization of Matrices, Cayley-Hamilton theorem and its applications to find inverse.

References:-

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition,Pearson, Reprint, 2002.

2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint, 2010.

5. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

BEBSC-102 Engineering Chemistry

BEBSC-102	**Engineering Chemistry**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preamble:

1. To acquire knowledge about hardness of water and importance of water in industrial purpose.
2. To understand the concept of molecular spectroscopy.
3. To gain the knowledge of about polymeric material and biodegradable substances.
4. To understand the mechanism of lubricant and properties of lubricant.

Outcomes:

1. Develop innovative methods to produce soft water for industrial use.
2. Identify the structure of unknown / new compounds with the help of spectroscopy.
3. Substitute metal with conducting polymers and produce cheaper biodegradable polymers to reduce environmental pollution.
4. Apply their knowledge for use and protect to industrial and domestic equipment.

UNIT-I Atomic and molecular structure (6Hrs)

Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. water treatment- Introduction, hardness of water, Units of hardness, disadvantage of hard water, scale and sludge formation in boilers, boilers troubles.

UNIT-II Spectroscopic techniques and applications (10Hrs)

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

UNIT-III Intermolecular forces and potential energy surfaces (6Hrs)

Ionic, dipolar and van Der Waals interactions. Lubricant-Introduction, mechanism of lubricant, classification of lubricant, properties of lubricating oils.

UNIT-IV Use of free energy in chemical equilibria (10Hrs)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. High Polymers-Introduction,

nomenclature, types of polymerization, classification of polymers, plastics-important, thermo-plastic resins and thermo setting resin.

UNIT-V Periodic properties (10Hrs)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries**.**

REFRENCES:

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
   Fundamentals of Molecular Spectroscopy, by C. N. Banwell
3. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.
4. Physical Chemistry, by P. W. Atkins
5. engg. Chemistry jain.jain
6. engg. Chemistry shashi chawla.

BEBSC-102	**Engineering Chemistry**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

LIST OF EXPERIMENTS:

1. Determination of surface tension and viscosity
2. Determination of chloride content of water
3. Determine the change of viscosity of given lubricating oil with change in temperature by Redwood Viscometer No. 1.
4. Determine the change of viscosity of given lubricating oil with change in temperature by Redwood Viscometer No. 2.
5. To determine the flash and fire point of given lubricating oil by Cleveland's open cup apparatus.
6. To determine the flash and fire point of given lubricating oil by Abel's closed cup apparatus.
7. To determine the flash and fire point of given lubricating oil by Pensky Marten's apparatus.
8. To determine the total hardness of given water sample by titrating it against EDTA solution using EBT as an indicator.

Laboratory Outcomes:

The students will learn to:

- Estimate rate constants of reactions from concentration of reactants/products as a function of time
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
- Synthesize a small drug molecule and analyse a salt sample

BEHSMC-103 English for Communication

BEHSMC-103	**English for Communication**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles

- To enhance Professional competence in reading, writing, listening and speaking.
- To modify the tactic of providing information about the language by using several techniques.
- To minimize the Grammar Translation Method of ELT by replacing it with Direct Learning Method.
- To Introduce Communicative Method of ELT and focusing the teaching pedagogy to the student-centered learning rather than the teacher-centered learning.
- To develop the skills to master three major forms of communications which are vital in academic and professional settings namely professional presentations, interviews and group communications respectively.
- To provide a deep insight of techniques for delivering effective presentations, appealing job interviews, and actively participating in various forms of group communication.

Course Outcomes:

At the end of this course students will have:

- Ability to design a language component or process to meet desired need within Realistic, Constraints such as economic, environmental, social, political, ethical Scenario.
- Ability to analyze the usage of English words in different contexts.
- An understanding of technical and academic articles' comprehension.
- The ability to present oneself at multinational levels knowing the type of different Standards of English

UNIT-I Identifying Common errors in writing (6 Hrs):

Articles, Subject-Verb Agreement, Prepositions, Active and Passive Voice, Reported Speech: Direct and Indirect, Sentence Structure.

UNIT-II Vocabulary building and Comprehension (6 Hrs)

Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, synonyms, antonyms, Reading comprehension.

UNIT-III Communication: (10 Hrs)

Introduction, Meaning and Significance, Process of Communication, Oral and Written Communication, 7 c's of Communication, Barriers to Communication and Ways to overcome them, Importance of Communication for Technical students, nonverbal communication.

UNIT-IV Developing Writing Skills (10 Hrs)

Planning, Drafting and Editing, Precise Writing, Précis, Technical definition and Technical description. Report Writing: Features of writing a good Report, Structure of a Formal Report, Report of Trouble, Laboratory Report, Progress Report.

UNIT-VBusiness Correspondence (10 Hrs):

Importance of Business Letters, Parts and Layout; Application, Contents of good Resume, guidelines for writing Resume, Calling/ Sending Quotation, Order, Complaint, E-mail and Tender.

References:-

1. 'Technical Communication : Principles and practice', Meenakshi Raman and Sangeeta Sharma (Oxford)
2. 'Effective Business Communication', Krizan and merrier (Cengage learning)
3. 'Communication Skill, Sanjay Kumar and pushlata, OUP2011
4. "Practical English Usage Michael Swan OUP, 1995.
5. "Exercises in spoken English Parts I-III CIEFL, Hyderabad, Oxford University Press
6. On writing well, William Zinsser, Harper Resource Book 2001.
7. Remedial English Grammar, F.T. Wood,Macmillan2007.

BEHSMC-103	**English for Communication**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments:-

1. Listening Comprehension.
2. Pronunciation, Intonation, Rhythm
3. Practicing everyday dialogues in English
4. Interviews.
5. Formal Presentation

BEESC-104 Basic Electrical Engineering

BEESC-104	**Basic Electrical Engineering**	**2L:0T:0P**	**2 credits**	**2Hrs/Week**

Course Preambles:

Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context and to provide students the working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices.

Course Outcomes

- To understand and analyze basic electric and magnetic circuits
- To study the working principles of electrical machines and power converters.
- To introduce the components of low voltage electrical installations

Unit-I Electrical circuit elements (10 Hrs):

Electrical circuit elements (R, L and C), Concept of active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, Kirchhoff's laws, Loop and-delta transformation, nodal methods, Superposition of a theorem, Thevenin theorem, Norton theorem.

Unit-II AC Circuits (10 Hrs):

Representation of Sinusoidal waveforms –Average and effective values, Form and peak factors, Concept of phasors, phasor representation of sinusoidally varying voltage and current. Analysis of single phase AC Circuits consisting of R, L, C, RL, RC, RLC combinations (Series and Parallel), Apparent, active & reactive power, Power factor, power factor improvement. Concept of Resonance in series & parallel circuits, bandwidth and quality factor. Three phase balanced circuits, voltage and current relations in star and delta connections.

Unit-III Magnetic circuit (6 Hrs)

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Unit-IV Machines (10 Hrs):

DC machines: Principle & Construction, Types, EMF equation of generator and torque equation of motor, applications of DC motors (simple numerical problems)

Three Phase Induction Motor: Principle & Construction, Types, Slip-torque characteristics, Applications (Numerical problems related to slip only)

Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications.

Three Phase Synchronous Machines: Principle of operation of alternator and synchronous motor and their applications.

Unit-V Components of LT Switchgear: (6 Hrs)

Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Importance of earthing. Types of Batteries, Important characteristics for Batteries.Elementary calculations for energy consumption and savings, battery backup.

Reference's: -

1. Ritu Sahdev, "Basic Electrical Engineering",
2. S. Singh, P.V. Prasad, "Electrical Engineeri
3. D. P. Kothari and ElectricalI.J.Nagrath,Engineering","Basic Tat
4. D. C. Kulshreshtha, "Basic Electrical Engine
5. E. Hughes, "Electrical and Electronics Techn
6. 6. S. Bobrow, "Fundamentals of Electrical En
7. 7.V. D. Toro, "Electrical Engineering Fundamen

BEESC-104	**Basic Electrical Engineering**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

Laboratory Preambles:

1. Read and demonstrate the rating of basic equipments used in electrical engineering
2. Connections of different components as per the rules
3. Application different components in electrical field

Laboratory Outcomes

1. Get an exposure to common electrical components and their ratings.
2. Make electrical connections by wires of appropriate ratings.
3. Understand the usage of common electrical measuring instruments.
4. Understand the basic characteristics of transformers and electrical machines.

List of Experiments: -

1. Verification of Kirchhoff's laws
2. Verification of Superposition and Thevenin Theorem.
3. Measurement of power and power factor in a single phase ac series inductive circuit and study improvement of power factor using capacitor
4. Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.
5. Connection and measurement of power consumption of a fluorescent lamp (tube light).
6. Measurement of power in 3- phase circuit by two wattmeter method and determination of its power factor for star as well as delta connected load.
7. Determination of parameters of ac single phase series RLC circuit
8. To observe the B-H loop of a ferromagnetic material in CRO.
9. Determination of (i) Voltage ratio (ii) polarity and (iii) efficiency by load test of a
10. single phase transformer

11. Determination of efficiency of a dc shunt motor by load test
12. To study running and speed reversal of a three phase induction motor and record speed in both directions.
13. Demonstration of cut-out sections of machines: dc machine, three phase induction machine, single-phase induction machine and synchronous machine.

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BEESC-105 Engineering Graphics and Design

BEESC-105	**Engineering Graphics and Design**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles

PREAMBLES:-

1. Increase ability to communicate with people.
2. Learn to sketch and take field dimensions.
3. Learn to take data and transform it into graphic drawings.
4. Learn basic Auto Cad skills.
5. Learn basic engineering drawing formats.
6. Prepare the student for future Engineering positions.

OUTCOMES: -

Student's ability to hand letter will improve.

1. Student's ability to perform basic sketching techniques will improve.
2. Students will be able to draw orthographic projections and sections.
3. Student's ability to use architectural and engineering scales will increase.
4. Students ability to produce engineered drawings will improve
5. Student's ability to convert sketches to engineered drawings will increase.
6. Students will become familiar with office practice and standards.
7. Students will become familiar with Auto Cad two dimensional drawings.
8. Students will develop good communication skills and team work.

UNIT-I Introduction to Engineering Drawing (10 Hrs):

Principles of Engineering Graphics and their significance, usage of Drawing instruments, Lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales –Plain, Diagonal and Venire Scales;

UNIT-II Orthographic Projections **(10 Hrs):**

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes; Projections of Regular Solids those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale

UNIT-III Sections and Sectional Views of Right Angular Solids (6 Hrs):

Prism, Cylinder, Pyramid, Cone –Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only).

UNIT-IV Isometric Projections: **(6 Hrs):**

Principles of Isometric projection –Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

UNIT-V Overview of Computer Graphics: (10 Hrs):

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Objects, Isometric Views of lines, Planes, Simple and compound Solids; Customization & CAD Drawing consisting of set up of the drawing page and the printer, including scale settings, Setting up of Units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance.

References:-

1.Bhatt N.D., Paschal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House

2.Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education

3.Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication

4.Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers

5.CAD Software Theory and User Manuals

BEESC-105	**Engineering Graphics and Design**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments:-

1. Sketching and drawing of geometries and projections based on above syllabus
2. Term work: A min. of 30 hand drawn sketches (on size A4 graphic sketch Book) plus 5 CAD-printouts on size A4 sheets plus 10 sheets of size A2 or 6 sheets of size A1, (50% marks to be allotted for this record + 25% marks for attendance +25%marks for Teachers Assessment

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BEESC-106 Manufacturing Practices

BEESC-106	**Manufacturing Practices**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

Course Preambles:

1. To understand process of cutting shaping.
2. To understand working principles for various machining processes.
3. To understand construction, working and applications of various machine tools.
4. To learn basic set up, working and applications of a few important non conventional machining processes to get hand on experience on various machine tools.

Course Outcomes:

1. The students will be able to understand the details about machines used in production.
2. The students will be able to understand the mechanics behind metal cutting.
3. The students will be able to understand the finishing and super finishing processes.
4. The students will be able to understand the Physics of material removal behind the various non-conventional machining processes.

Manufacturing is fundamental to the development of any engineering product. The course on Engineering Workshop Practice is intended to expose engineering students to different types of manufacturing / fabrication processes, dealing with different materials such as metals, ceramics, plastics, wood, glass etc. While the actual practice of fabrication techniques is given more weightage, some lectures and video clips available on different methods of manufacturing are also included.

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. CNC machining, Additive manufacturing
3. Fitting operations & power tools
4. Carpentry
5. Plastic molding, glass cutting
6. Metal casting
7. Welding (arc welding & gas welding), brazing

List of Experiments:-

1. Carpentry Shop Experiment To Make a T-LAP joint with wood Pieces
2. Machine Shop Experiment To Perform Knurling on Iron Rod
3. WELDING SHOP (LAP Joint) , Tools, Accessories, Diagram And Explanation
4. SHEET METAL SHOP (Square Tray) , Parts, Accessories, Diagram And Explanation
5. FITTING SHOP (Make a Joint) , Parts, Accessories, Diagram And Explanation
6. CARPENTRY SHOP (T-Lap Joint) , Cutting Tools, Accessories, Diagram and Explanation
7. MACHINE SHOP (the lathe machine) , Parts, Accessories, Diagram and Explanation

BELC 207 Industrial Training

BELC 207	**Industrial Training**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

- Industrial environment and work culture.
- Organizational structure and inter personal communication.
- Machines/ equipment/ instruments - their working and specifications.
- Product development procedures and phases.
- Project planning, monitoring and control.

BEBSC-201 Mathematics-II

BEBSC-201	**Mathematics-II**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles

1. To introduce the basic concepts required to understand, construct, solve and interpret differential equations.
2. To teach methods to solve differential equations of various types.
3. To give an ability to apply knowledge of mathematics on engineering problems

Course Outcomes

The students will be able to :

1. Classify differential equations according to certain features.
2. Solve first order linear equations and nonlinear equations of certain types and interpret the solutions.
3. Understand the conditions for the existence and uniqueness of solutions for linear differential equations
4. Solve second and higher order linear differential equations with constant coefficients and construct all solutions from the linearly independent solutions
5. Find series solutions about ordinary and regular singular points for second order linear differential equations.
6. Solve initial value problems using the Laplace transform.
7. Solve systems of linear differential equations with methods from linear algebra

Unit - I Ordinary Differential Equations I (6 Hrs):

Differential Equations of First Order and First Degree (Leibnitz linear, Bernoulli's, Exact), Differential Equations of First Order and Higher Degree, Higher order differential equations with constants coefficients, Homogeneous Linear Differential equations, Simultaneous Differential Equations.

UNIT-II Ordinary differential Equations II (6 Hrs):

Second order linear differential equations with variable coefficients, Method of variation of parameters, Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Unit III Partial Differential Equations (10 Hrs)

Formulation of Partial Differential equations, Linear and Non-Linear Partial Differential Equations, Homogeneous Linear Partial Differential Equations with Constants Coefficients.

Unit IV Functions of Complex Variable (10 Hrs)

Functions of Complex Variables: Analytic Functions, Harmonic Conjugate, Cauchy-Riemann Equations (without proof), Line Integral, theorem ,Cauchy Integral formula (without proof), Singular Points, Poles & Residues, Residue Theorem, Application of Residues theorem for Evaluation of Real Integral

Unit V Vector Calculus (10 Hrs)

Differentiation of Vectors, Scalar and vector point function, Gradient, Geometrical meaning of gradient, Directional Derivative, Divergence and Curl, Line Integral, Surface Integral and Volume Integral, Gauss Divergence, Stokes and Green theorems.

References : -

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint,

2002.

2. Erwin kreyszig , Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,
2006.

3. W. E. Boyce and R. C. Dip Rima, Elementary Differential Equations and Boundary Value Problems, 9th

End., Wiley India,
2009.

4. S. L. Ross, Differential Equations, 3rd Ed., Wiley India,
1984.

5. E. A. Codington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.

6. E. L. Inca, Ordinary Differential Equations, Dover Publications, 1958.

7. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., McGraw Hill,

2004.

8. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

9. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

BEBSC- 202 Engineering Physics

BEBSC- 202	**Engineering Physics**	**2L:1T:0P**	**3 credits**	**3Hrs/Week**

Preambles

- A comprehensive, high-quality education in the physical sciences
- A flexible curriculum with multiple concentrations that allows students to tailor their education according to their specific interests
- The opportunity to experience the excitement of scientific discovery through direct participation in faculty research
- An increased awareness of the physical processes in the surrounding world
- The essential knowledge and analytical, mathematical and computational tools with which to pursue post-graduate education in a variety of physics-related and other fields
- The foundation and practical skillsets for eventual success in any of a broad array of careers
- The motivation for a lifelong love of learning

Outcomes

- An ability to apply knowledge of mathematics, science, and engineering.
- An ability to design and conduct experiments, as well as to analyze and interpret data.
- An ability to design a system, component, or process to meet desired needs within realistic constraints.
- An ability to function on multidisciplinary teams.
- An ability to identify, formulate, and solve engineering problems.
- An understanding of professional and ethical responsibility.
- An ability to communicate effectively.
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
- A recognition of the need for, and an ability to engage in life-long learning.
- A knowledge of contemporary issues.
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Unit I Relativistic Mechanics: (6 Hrs):

Frame of reference, Inertial & non-inertial frames, Galilean transformations, Michelson-Morley experiment, Postulates of special theory of relativity, Lorentz transformations, Length contraction, Time dilation, Velocity addition theorem, Variation of mass with velocity, Einstein's mass energy relation, Relativistic relation between energy and momentum, Massless particle.

Unit II Solid state & Nuclear physics (10 Hrs):

Free electron theory of metals, Qualitative discussion of Kronig-penny model and origin of energy bands. Intrinsic and Extrinsic Semiconductors. V-I Characteristics of PN junction diode, Zener diode, Hall-effect.

Introduction to Nuclear Physics , Static properties of Nucleus,Nuclear liquid drop model, Nuclear Shell Model, Linear particle accelelerator, Cyclotron, Betatron, Bainbridge mass sprectrograph.

Unit III Quantum Mechanics: (6Hrs):

Introduction to Quantum mechanics, Wave particle duality, Matter waves, Particle velocity, Phase velocity , Group velocity and their relation. Heisenberg's Uncertainty Principle. Time-dependent and time-independent Schrodinger wave equation, Solution to stationary state Schrodinger wave equation for one-Dimensional particle in a box, Compton effect.

Unit IV Wave Optics: (10 Hrs):

Interference :Coherent sources, Interference in uniform and wedge shaped thin films, Newton's Rings and its applications. Fraunhoffer diffraction at single slit and at double slit, Absent spectra, Diffraction grating, Spectra with grating, Dispersive power of grating, Rayleigh's criterion of resolution. Resolving power of grating and Prism.

Unit V Fibre Optics & Lasers: Fibre Optics(10 Hrs):

Introduction to fibre optics, Acceptance angle, Numerical aperture, Normalized frequency, Classification of fibre, Attenuation and Dispersion in optical fibres.

Laser: Absorption of radiation, Spontaneous and stimulated emission of radiation, Einstein's coefficients, Population inversion, Various levels of Laser, Ruby Laser, He-Ne Laser, Laser applications.

Reference Books: -

1. Concepts of Modern Physics - AurthurBeiser (Mc-Graw Hill)

2. Introduction to Special Theory of Relativity- Robert Resnick (Wiley)

3. Optics - Brijlal& Subramanian (S. Chand)

4. Engineering Physics: Theory and Practical- Katiyar and Pandey (Wiley India)

5. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New)

6. Engineering Physics-Malik HK and Singh AK (McGrawHill)

BEBSC- 202	**Engineering Physics**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments: -

1. To determine the wavelength of sodium light by Newton's ring experiment.

2. To determine the wavelength of different spectral lines of mercury light using plane transmission grating.

3. To determine the energy band gap of a given semiconductor material.

4. To determine the plank's constant with help of photocell.

5 .Resolving Power of Telescope.

6 .V-I Charecteristics of P-N Junction diode.

7. Zener diode characteristics.

8. To determine the dispersive power of prism.

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BTEESC-203 Basic Computer Engineering

BTEESC-203	**Basic Computer Engineering**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preamble:-

- Successfully practice computer engineering to serve state and regional industries, government agencies, or national and international industries.
- Work professionally in one or more of the following areas: computer hardware and software design, embedded systems, computer networks and security, system integration, and electronic design automation.
- Achieve personal and professional success with awareness and commitment to their ethical and social responsibilities, both as individuals and in team environments.
- Maintain and improve their technical competence through lifelong learning, including entering and succeeding in an advanced degree program in a field such as engineering, science, or business.

Outcome:-

- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- an ability to communicate effectively with a range of audiences
- an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

Unit –I Computer: (6Hrs):

Definition, Classification, Organization i.e. CPU, register, Memory & Storage Systems, I/O Devices, and System & Application Software. Computer application E-Business, Bio-Informatics, health Care, Remote Sensing & GIS, Meteorology and, Computer Gaming, Multimedia and Animation etc.

Unit –II Introduction to Algorithms (6 Hrs):

Complexities and Flowchart, Introduction to Programming, Categories of Programming Languages, Program Design, Programming Paradigms, Characteristics or Concepts of OOP, Procedure Oriented Programming VS object oriented Programming.

Introduction to C, Character Set, Tokens, Precedence and Associativity, Program Structure, Data Types, Variables, Operators, Expressions, Statements and control structures, I/O operations, Array, Functions,

Unit – III Computer System Overview (10 Hrs):

Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview- Preambles and functions, Evolution of Operating System. - Computer System Organization- Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.

Unit IV Computer Networking (10 Hrs):

Introduction, Goals, OSI Model, Functions of Different Layers. Internetworking Concepts, Devices, TCP/IP Model. Topology, Introduction to Internet, World Wide Web, E• commerce Computer Security Basics: Introduction to viruses, worms, malware, Trojans, Spyware and Anti-Spyware Software, Different types of attacks like Money Laundering, Information Theft, Cyber Pornography, Email spoofing, Denial of Service (DoS), Cyber Stalking, ,Logic bombs, Hacking Spamming, Cyber Defamation, Security measures Firewall,

Unit V Data base Management System (10 Hrs):

Introduction, File oriented approach and Database approach, Data Models, Architecture of Database System, Data independence, Data dictionary, DBA, Primary Key, Data definition language and Manipulation Languages. Cloud computing: definition, cloud infrastructure, cloud segments or service delivery models (IaaS, PaaS and SaaS), cloud deployment models/ types of cloud (public' private, community and hybrid clouds), Pros and Cons of cloud computing

Reference books:

1. Introduction of computers: Peter Norton, TMH
2. Object oriented programming with c++ :E.Balaguruswamy,TMH
3. Object oriented programming in C++: Rajesh k.shukla ,Wiley India
4. Computer network: Andrew Tananbaum,PHI
5. Data base management system,Korth,TMH
6. Operating system-silberschatz and Galvin-Wiley India

BTEESC-203	Basic Computer Engineering	0L:0T:1P	1 credits	2Hrs/Week

List of Experiment:-

1. Study of input and output devices of computer systems .
2. Write a program of addition, subtract, multiplication and division by using C.
3. Write a program to check weather a number is prime or not.
4. Study of various types of Operating System.
5. Study and practice of basic Linux commands-ls, cp, mv, rm, chmod kill, ps etc.
6. Design color coding of straight & crossover cable.
7. Installation of oracle 10g. Also create a employee table.

BEESC-204 Basic Mechanical Engineering

BEESC-204	Basic Mechanical Engineering	2L:0T:0P	2 credits	2Hrs/Week

Preamble:

- To provide a comprehensive knowledge of basic mechanical systems.
- Basic concepts from mechanical engineering sciences,
- Basic concepts I.C Engine
- Modern engineering tools (machine-tools, laboratory instrumentation, Working principle of steam Engine), and related subjects to design mechanical engineering components

Outcome:

- After successful completion of this course students will able to
- To describe and use basic engineering concepts
- principles and components of mechanical equipment
- measuring & testing method of physical quantities

- Assessment of boiler component.

Unit I Materials (6 Hrs):

Classification of engineering material, Composition of Cast iron and Carbon steels, Iron Carbon diagram. Alloy steels their applications. Mechanical properties like strength, hardness, toughness ductility, brittleness , malleability etc. of materials , Tensile test- Stress-strain diagram of ductile and brittle materials ,

Unit II Measurement (10 Hrs):

Concept of measurements, errors in measurement, Temperature, Pressure, Velocity, Flow strain, Force and torque measurement, Vernier caliper, Micrometer, Dial gauge, Slip gauge, Sine-bar and Combination set. Production Engineering: Elementary theoretical aspects of production processes like casting, carpentry, welding etc Introduction to Lathe and Drilling machines and their various operations.

Unit III Fluids (6Hrs):

Fluid properties pressure, density and viscosity etc. Types of fluids , Newton's law of viscosity , Pascal's law , Bernoulli's equation for incompressible fluids, Only working principle of Hydraulic machines, pumps, turbines, Reciprocating pumps .

Unit IV Thermodynamics (10Hrs):

Thermodynamic system, properties, state, process, Zeroth, First and second law of thermodynamics, thermodynamic processes at constant pressure, volume, enthalpy & entropy.

Steam Engineering: Classification and working of boilers, mountings and accessories of boilers, Efficiency and performance analysis, natural and artificial draught, steam properties, use of steam tables.

Unit V Reciprocating Machines (10 Hrs) :

Working principle of steam Engine, Carnot, Otto, Diesel and Dual cycles P-V & T-S diagrams and its efficiency, working of Two stroke & Four stroke Petrol & Diesel engines. Working principle of compressor.

References : -

1- Kothandaraman & Rudramoorthy, Fluid Mechanics & Machinery, New Age . 2- Nakra & Chaudhary , Instrumentation and Measurements, TMH.

3- Nag P.K, Engineering Thermodynamics , TMH .

4- Ganesan , Internal Combustion Engines, TMH .

5- Agrawal C M, Basic Mechanical Engineering ,Wiley Publication. 6- Achuthan M , , Engineering Thermodynamics ,PHI.

BEESC-204	**Basic Mechanical Engineering**	**0L:0T:1P**	**2 credits**	**2Hrs/Week**

List of Experiments:-

1- Study of Universal Testing machines.

2- Linear and Angular measurement using, Micrometer, Slip Gauges, Dial Gauge and

3- Study of Lathe Machine.

4- Study of Drilling Machines.

5- Verification of Bernoulli's Theorem.

6- Study of various types of Boilers.

7- Study of different IC Engines.

8- Study of different types of Boilers Mountings and accessories.

BEESC-205 Basic Civil Engineering & Mechanics

BEESC-205	**Basic Civil Engineering & Mechanics**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preamble: The goal of this Engineering Mechanics course is to expose students to problems in mechanics as applied to plausibly real-world scenarios. Problems of particular types are explored in detail in the hopes that students will gain an inductive understanding of the underlying principles at work; students should then be able to recognize problems of this sort in real-world situations and respond accordingly.

The civil engineering program will serve Connecticut and the nation by providing a quality engineering education that enables students to enter a profession that can improve the civil infrastructure, and economic welfare. Our civil engineering program will maintain a strong emphasis on undergraduate education with the goal that our program will be recognized for quality instruction in civil engineering analysis and design

Outcomes:

- Demonstrate knowledge of various surveying methods.
- Conduct a chain survey.
- Conduct a compass survey.
- Conduct levelling survey and be able to do RL calculations.
- Demonstrate knowledge of properties of various building materials.
- Draw free body diagrams and determine the resultant of forces and/or moments.
- Determine the centroid and second moment of area of sections.
- Apply laws of mechanics to determine efficiency of simple machines with consideration of friction.
- Analyse statically determinate planar frames.

Unit I Building Materials & Construction (10 Hrs)

Stones, bricks, cement, lime, timber-types, properties, test & uses, laboratory tests concrete and mortar Materials: Workability, Strength properties of Concrete, Nominal proportion of Concrete preparation of concrete, compaction, curing. Elements of Building Construction, Foundations conventional spread footings, RCC footings, brick masonry walls, plastering and pointing, floors, roofs, Doors, windows, lintels, staircases – types and their suitability

Unit II Surveying & Positioning (10 Hrs):

Introduction to surveying Instruments – levels, theodolites , plane tables and related devices. Electronic surveying instruments etc. Measurement of distances – conventional and EDM methods, measurement of directions by different methods, measurement of elevations by different methods. Reciprocal levelling .

Unit III Basics of Engineering Mechanics covering (10 Hrs):

Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces ,Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy

Unit IV Centroid and Centre of Gravity covering (10 Hrs):

Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia Definition, Moment of inertia of plane sections

from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

Unit V Friction covering (10 Hrs):

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames

Reference Books:

1. S. Ramamrutam & R.Narayanan; Basic Civil Engineering, Dhanpat Rai Pub.

2. Prasad I.B., Applied Mechanics, Khanna Publication.

3. Punmia, B.C., Surveying, Standard book depot.

4. Shesha Prakash and Mogaveer; Elements of Civil Engg & Engg. Mechanics; PHI

BEESC-205	**Basic Civil Engineering & Mechanics**	**0L:0T:2P**	**1 credits**	**2Hrs/Week**

List of Experiments:-

1. To perform traverse surveying with prismatic compass, check for local attraction and determine corrected bearings and to balance the traverse by Bowditch's rule.

2. To perform leveling exercise by height of instrument of Rise and fall method.

3. To measure horizontal and vertical angles in the field by using Theodolite.

4. To determine (a) normal consistency (b) Initial and Final Setting time of a cement Sample.

5. To determine the workability of fresh concrete of given proportions by slump test or compaction factor test.

6. To determine the Compressive Strength of brick .

7. To determine particle size distribution and fineness modulus of course and fine Aggregate.

8. To verify the law of Triangle of forces and Lami's theorem.

9. To verify the law of parallelogram of forces.

10. To verify law of polygon of forces

11. To find the support reactions of a given truss and verify analytically.

12. To determine support reaction and shear force at a given section of a simply Supported beam and verify in analytically using parallel beam apparatus.

13. To determine the moment of inertia of fly wheel by falling weight method.

14. To verify bending moment at a given section of a simply supported beam.

SCHOOL OF ENGINEERING

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Undergraduate Degree Courses in Engineering & Technology

Department of Chemical Engineering

BEHSMC-206 Language Lab and Seminar

BEHSMC-206	**Language Lab and Seminar**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

Course Preamble: This course intends to impart practical training in the use of English Language for

Communicative purposes and aims to develop students' personality through language Laboratory.

Topics to be covered in the Language laboratory sessions:

1. **1.** Introducing oneself, family, social roles.
2. 2.Public Speaking and oral skills with emphasis on conversational practice, extempore speech, JAM(Just a minute sessions), describing objects and situations, giving directions, debate, telephonic etiquette.
3. Reading Comprehension: Intensive reading skills, rapid reading, and reading aloud (Reading material to be selected by the teacher).
4. To write a book review. Standard text must be selected by the teacher.
5. Role plays: preparation and delivery topic to be selected by teacher/faculty.

BELC–207 Self Study / GD Seminar

BELC–207	**Self-Study / GD Seminar**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

Preamble

To improve the mass communication and convincing / understanding skills of students and it is to give student an opportunity to exercise their rights to express themselves. Evaluation will be done by assigned faculty based on group discussion and power point presentation.

Outcomes:

- Analytical thinking
- Lateral thinking
- constructive argument
- Communication skill
- Presentation of views

Students will discuss the course related and interdisciplinary topics for problem solving. They will improve the mass communication and convincing / understanding skills about subject and their related problem in a group of students.

BEA-301 Mathematics-III

BEA-301	**Mathematics-III**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles:
To enable the students to apply the knowledge of Mathematics in various engineering fields by making them

- To understand the method of solving algebraic, transcendental equations and to determine the approximate value of the derivative & definite integral for a given data using numerical techniques.
- Able to expand the given periodic function defined in the given range in terms of sine and cosine multiple of terms as a Fourier series and to extremise the functional using integration technique and to solve the partial differential equation using different analytical techniques.

Course outcomes:
On completion of this course, students will be able to

- Solve field problems in Engineering involving PDEs.
- Use the root finding techniques to solve practical engineering problems.
- To apply the concept of numerical analysis to find the relative strengths and weaknesses of each computation method and know which are most applicable for given problem.
- To apply the analytical technique to express periodic function as a Fourier sine and cosine series.
- Estimate Laplace and Fourier transform and z transform.

Unit I: Numerical Methods (10 hours): Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae.

Unit II: Numerical Methods (7 hours): Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules. Solution of Simultaneous Linear Algebraic Equations by Gauss's Elimination, Gauss's Jordan, Crout's methods, Jacobi's, Gauss-Seidal, and Relaxation method.,

Unit III: Numerical Methods (10 hours): Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. RungeKutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. Partial differential equations: Finite difference solution two dimensional Laplace equation and Poission equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation.

Unit IV: Transform Calculus (10 hours): Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs by Laplace Transform method, Fourier transforms.

Unit V: Concept of Probability (5 hours): Probability Mass function, Probability Density Function, Discrete Distribution: Binomial, Poisson's, Continuous Distribution: Normal Distribution, Exponential Distribution.

References:

1. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
2. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
3. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
7. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book
8. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
9. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968. Statistics.

SCHOOL OF ENGINEERING

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Undergraduate Degree Courses in Engineering & Technology

Department of Chemical Engineering

CMA-302 Chemical Engineering Thermodynamics

CMA-302	**Chemical Engineering Thermodynamics**	**2L:1T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles:

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

Course Outcomes:

- Apply mass and energy balances to closed and open systems
- Evaluate the properties of non-ideal gases
- Solve problems involving liquefaction, refrigeration and different power cycles.

Unit-I: Basic Concepts (10 hours): Basic concepts of work & heat system, properties and state of systems; first law of thermodynamics; application, batch flow processes; steady & unsteady state flow.

Unit-II: Properties (10 hours): Critical properties corresponding state compressibility, PVT behavior of pure fluids viral equation, cubic equation, generalized correlation & eccentric factor, behavior of liquid, second law of T.D, & its application. Adiabatic reactions, Equilibrium in homogeneous and heterogeneous reactions.

Unit-III: Carnot Cycle (8 hours): Carnot cycle, Carnot theorem, thermodynamics temperature scales, concept of entropy, calculation of entropy for various systems, entropy for real system.

Unit-IV: Effect of Pressure (5 hours): Effect of pressure on specific heat, Joule Thompson effect, third law of thermodynamics & its applications.

Unit-V: Compression & Expansion of Fluids (7 hours): Compression & expansion of fluids; single stage, multiple stage requirements & efficiency along with effect & engineering along with effects clearance, compression of real gas.

References:

1. Smith J.M and Van Ness-Introduction to Chemical Engg Thermodynamics –6th edition
2. Daubert; Chemical Engg thermodynamic; TMH
3. Rathakrishnan E; Fundamentals of Engg Thermodynamics; PHI
4. Dodge B.F. Chemical Engineering –Thermodynamics –McGraw Hill
5. Balzhiser, Samuels and Eliassen-Chemical Engg- Thermodynamics Prentice Hall
6. Sandler S.I Chemical Engg-Thermodynamics-John Wiley and son
7. Rastogi and Mishra-Chemical Engg Thermodynamics.

SCHOOL OF ENGINEERING

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Undergraduate Degree Courses in Engineering & Technology

Department of Chemical Engineering

CMA-303 Advance Engineering Chemistry

CMA-303	Advance Engineering Chemistry	3L:0T:0P	3 credits	3Hrs/Week

Course Preambles:

- Concepts of quantum chemistry, bonding, stereochemistry, and those of Synthesis methodologies and reactivity of organic compounds.
- Concepts related to homogeneous and heterogeneous catalysis, mechanisms of industrially important reactions, spectroscopic methods for identification of compounds.

Course Outcomes:

Students taking the course will

- Get an understanding of the theoretical principles underlying molecular structure, bonding and properties.
- Know the fundamental concepts of structure and function in organic reactions, the use of kinetics and thermodynamics to elucidate mechanisms of reactions.
- Be able to predict reactivity patterns and propose reasonable mechanisms.

Unit-I: Ceramics (10 hours): Definition & Classification of ceramic materials based on composition, properties & applications, Electro-ceramics, magnetic ceramics, Fine ceramics & Glass-ceramics Natural ceramic minerals & materials such as Clay family, Quartz/Quartzite, Feldspar, Bauxite family, Dolomite, Magnesite.

Unit-II: Refractory (12 hours): Introduction, raw materials, Fabrication and firing, General manufacturing techniques, Properties and applications of following refractories: Acid (Silica) Refractories, Basic Refractories, Burnt refractories ,Sintered, fused refractories,and Insulating Refractories, Castables.

Unit-III: Glass (10 hours): Definition of glass, Thermodynamic study for glass formation, Glass transitions Conditions of vitrification; Glass processing: selection of raw materials, effects of different oxides on glass properties, batch preparation, melting in glass tank furnace, refining of glass, Forming process: Blowing, molding , shaping etc

Unit-IV: Oils and Fats (8 hours): Vegetable oils by solvent extraction, processing of animal fats, hydrogenation and esterification of oils; Soaps and Detergents Bathing & laundry soaps, cationic and anionic detergents;, surface active agents.

Unit-V: Chemical Kinetics (12 hours): Rate constant, order and molecularity of a reaction, zero, 1st, 2nd and 3rdorder reactions; , methods of determination of order of reactions; chemical equilibria Reaction rate theories, Arrhenius, parameters, Catalysis (including enzyme catalysis), effect of catalysis on reaction rate.

References:

1. B.S.Bahl & G. D. Tuli- Essentials of physical Chemistry. S. Chand & Publishers.
2. Glasstone – Textbook on Physical Chemistry – Prentice Hall, India, New Delhi.
3. Dryden CE- Outlines of Chemical Technology- Prentice Hall, India, New Delhi
4. Levine; Physical Cheistry; TMH.
5. Sivasamkar; Engg Chemistry; TMH
6. Jain & Jain- Engineering Chemisry – Dhanpat Rai Publishing Company, Delhi.
7. 7.Austin G.T, Shreeves; Chemical Process Industry – McGraw Hill – Kogmina
8. Gupta OP; Fuel and Combustion; Khana Pub

CMA-303	**Advance Engineering Chemistry**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments:

1. To determine the viscosity of a viscous liquid by falling sphere method
2. Determination of saponification value of oil sample
3. Application of pH meter to find acidity and alkalinity of a solution.
4. To determine the % composition of a given binary liquid solution by polarimeter.
5. To determine the solubility of a sparingly soluble salt in water by conductance measurement.
6. Preparation of laundry soap and to determine its yield
7. Investigation of Appropriate Refractory Material for Laboratory
8. Manufacturing of glass and ceramics in laboratory scale.

SCHOOL OF ENGINEERING

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Undergraduate Degree Courses in Engineering & Technology

Department of Chemical Engineering

CMA-304 Material & Energy Balance

CMA-304	Material & Energy Balance	2L:1T:0P	3 credits	3Hrs/Week

Course Preambles:

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

Course Outcomes:

Students completing the course will

- Develop mastery over process calculations relevant to chemical engineering processes
- Bee able to handle elementary flow-sheeting, material and energy balance calculations without and with chemical reactions, and involving concepts like recycle, bypass and purge.
- Be familiar with equations of state and properties of gases and liquids, including phase transition

Unit-I: Mathematical and Engineering Calculation (10 hours): Units, different unit systems, conversion of unit from one system to other, dimensions, dimensional analysis, dimensional group, fundamental of mole concept, composition of solid, liquid and gases, Basic Stoichiometric calculation.

Unit-II: Ideal Gases & Vapor Pressure (8 hours): Introduction of ideal gas, behavior of ideal gases, real gas, Vander Waal equation, compressibility factor method to solve cubic equation , vapour pressure , Raoult's Law, Humidity, relative humidity, humid heat, humid volume ,dew point ,humidity chart and its use.

Unit-III: Material Balance without Chemical Reaction (12 hours): Fundamental of conservation of mass, Introduction of component balance, solving material balance without simultaneous equation for different unit operations, solving material balance at steady state and unsteady state, recycle, by pass and purge calculations. Aid of computer in solving material balance problems.

Unit-IV: Material Balance with Chemical Reaction (10 hours): Introduction of component balance, solving material balance with chemical reactions, recycles, by pass and purge calculation with chemical reactions, combustion calculations.

Unit-V: Energy Balance (08 hours): Laws of thermo chemistry Heat capacity, calculation of enthalpy changes, calculation of standard heat of reaction, heats of formation, combustion, solution, mixing etc., effect of pressure and temperature on heat of reaction, energy balance with chemical reaction.

References:

1. O.A. Hougen, K.M. Watson, R.A. Ragatz; Chemical Process Principles Part I –CBS pub.
2. David M. Himmelblau-Basic Principles and calculations in chemical Engineering –PHI
3. B. I. Bhatt, S.M. Vora; Stoichiometry; TMH.

CMA-304	**Material & Energy Balance**	0L:0T:1P	1 credits	2Hrs/Week

List of Experiments:

1. Determination of boiling point relation with respect to concentration of caustic soda and verify Dehring' rule.
2. Application of dry and wet bulb thermometer to find out atmospheric humidity.
3. Use of humidity chart to find enthalpy dew point humid heat and saturation.
4. Solubility at room temperature and boiling point of urea in water and verify the material balance.
5. Crystallization of copper sulfate in saturated solution by cooling and finding out the crystal yield.
6. To find out the heating value of coal using a calorimeter
7. Combustion of coal & performing the material balance
8. Proximate analysis of coal sample
9. Measurement of flame temp and compare actual & theoretical temp (Bunsen-Burner, Sprit Lamp, Kerosene Lamp.)
10. To find the heat of reaction using calcium oxide and water.

SCHOOL OF ENGINEERING

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Undergraduate Degree Courses in Engineering & Technology

Department of Chemical Engineering

CMA-305 Chemical Instrumentation

CMA-305	Chemical Instrumentation	3L:0T:0P	3 credits	3Hrs/Week

Course Preambles:

Objective of the course is to introduce the basics of instrumentation and process control through a hands-on practical experience. Principles of operation of different measuring devices for temperature, level, pressure, flow, pH, humidity, density, and viscosity will be introduced to impart knowledge of transmitters, transducers, converters, control valves, digital and analog components related to PLC, DCS, SCADA systems.

Course Outcomes:

Students will be well-familiar with instrumentation and automation as relevant to modern chemical plant operation.

Unit-I: Introduction (10 hours): Chemical process instrumentation, Choice of Instruments for a Specific Application Process variables, static and dynamic characteristics of instruments & their general classification, Elements of Measuring systems & their functions, True value ,Measured Value, Errors, Classification Of Errors and Methods of Reducing errors.

Unit-II: Temperature of Humidity Measurement (15 hours): Principle, construction and operation of instruments for the measurement of Temperature: Liquid filled thermometers, Vapour Pressure Thermometers, Thermometers based on solid expansion like bimetallic type, Thermocouples, Resistance thermometers, Radiation Pyrometers, Optical Pyrometers, Photo electric Pyrometers. Principle, construction and operation of instruments for the measurement of Humidity and moisture

Unit-III: Pressure Measurement (12 hours): Principle, construction and operation of instruments for the measurement of pressure and Vacuum: Mechanical Pressure sensors e.g. Bourdon Tube, Diaphragm Pressure Elements, Bellows, Electrical Pressure Measuring Devices e.g. capacitance Manometer, Strain Gauge Pressure Transducers, Piezo Resistive Pressure Transducers, Resistive Pressure Transducers, LVDT Pressure Transducer. Measurement Of vacuum e.g Mcleod Gauge , Pirani gauge, Ionization gauge.

Unit-IV: Flow Measurement (10 hours): Principle, construction and operation of instruments for the measurement of Flow e.g. Variable Head flow meters, Variable Area flow meters, Hot Wire Anemometer, Principle, construction and operation of instruments for the measurement of Level e.g. Float and Displacer type Devices, Hydrostatic Methods, Capacitance type Devices , Radiation type Devices. Principle,construction and operation of instruments for the measurement of Density and Viscosity.

Unit-V: Composition Measurement (10 hours): Principle, construction and operation of instruments for the measurement of Composition e.g. Thermal conductivity analyzers,

Paramagnetic Analyzers, Spectroscopic Methods, Gas Chromatograph, Process instrumentation diagrams and symbols, process instrumentation for process equipments such as Distillation column Absorption column, Heat Exchanger, Reactors, Evaporators, fluid storage vessels.

References:

1. Albert D. Cooper-Modern Electronic Instrumentation, PHI
2. Eckman-Industrial Instrumentation
3. H.S. Kalsi-Electronic Instrumentation
4. Curties Johnson-Process Control Instrumentation Technique, IV Edn, PHI
5. Harriot; Process control; TMH
6. Patranabis; Principles of process control; TMH
7. Jaggi, Mathur; Engineering Mathematics; Khanna Publisher.
8. B.G. Liptak-Instrument Engineering 'Handbook, Volume 1: Process Measurement
9. Austin E. Fribance-Industrial Instrumentation Fundamentals, New York: Mcgraw-Hill 1962
10. Ernest Doebelin-Measurement Systems: Application and Design, McGraw-Hill

CMA-305	**Chemical Instrumentation**	0L:0T:1P	1 credits	2Hrs/Week

List of Experiments:

1. Time constant of pH-meter
2. Study of Bourdon tube pressure gauge
3. Study of Bellow tube pressure gauge
4. Calibration of different instruments used in chemical processes
5. Study of electro-pneumatic transducers for pressure, flow, level
6. Measurement of water level using differential pressure meter
7. Measurement of flow using electromagnetic flow meter
8. Measurement of flow using differential pressure cell across orifice/ venturimeter.

CMA-306 Computer Programming-I

CMA-306	Computer Programming-I	0L:0T:1P	1 credits	2Hrs/Week

Course Preambles:

- Programming in the Java programming language,
- Knowledge of object-oriented paradigm in the Java programming language,
- The use of Java in a variety of technologies and on different platforms.

Course Outcomes:

- Students will be able to solve simple problems in statistics, chemistry and physics using programming languages.
- To do coding of Java programming language for various programming technologies
- Knowledge of the structure and model of the Java programming language,
- Use the Java programming language for various programming technologies
- Develop software in the Java programming language

Unit-I Basic Java Features - C++ Vs JAVA, JAVA virtual machine, Constant & Variables, Data Types, Class, Methods, Objects, Strings and Arrays, Type Casting, Operators, Precedence relations, Control Statements, Exception Handling, File and Streams, Visibility, Constructors, Operator and Methods Overloading, Static Members, Inheritance: Polymorphism, Abstract methods and Classes

Unit-II Java Collective Frame Work - Data Structures: Introduction, Type-Wrapper Classes for Primitive Types, Dynamic Memory Allocation, Linked List, Stack, Queues, Trees, Generics: Introduction, Overloading Generic Methods, Generic Classes, Collections: Interface Collection and Class Collections, Lists, Array List and Iterator, Linked List, Vector. Collections Algorithms: Algorithm sorts, Algorithm shuffle, Algorithms reverse, fill, copy, max and min Algorithm binary Search, Algorithms add All, Stack Class of Package java. Util, Class Priority Queue and Interface Queue, Maps, Properties Class, Un-modifiable Collections.

Unit-III Advance Java Features - Multithreading: Thread States, Priorities and Thread Scheduling, Life Cycle of a Thread, Thread Synchronization, Creating and Executing Threads, Multithreading with GUI, Monitors and Monitor Locks. Networking: Manipulating URLs, Reading a file on a Web Server, Socket programming, Security and the Network, RMI, Networking, Accessing Databases with JDBC: Relational Database, SQL, MySQL, Oracle

Unit-IV Advance Java Technologies - Servlets: Overview and Architecture, Setting Up the Apache Tomcat Server, Handling HTTP get Requests, Deploying a web Application, Multitier Applications, Using JDBC from a Servlet, Java Server Pages (JSP): Overview, First JSP Example, Implicit Objects, Scripting, Standard Actions, Directives, Multimedia: Applets and Application: Loading, Displaying and Scaling Images, Animating a Series of Images, Loading and playing Audio clips

Unit-V Advance Web/Internet Programming (Overview): J2ME, J2EE, EJB, XML.

References:

1. Deitel & Deitel, "JAVA, How to Program"; PHI, Pearson.
2. E. Balaguruswamy, "Programming In Java"; TMH Publications
3. The Complete Reference: Herbert Schildt, TMH
4. Peter Norton, "Peter Norton Guide To Java Programming", Techmedia.
5. Merlin Hughes, et al; Java Network Programming, Manning Publications/Prentice Hall
6. Cay Horstmann, Big JAVA, Wiely India.

List of Program to be perform (Expandable):

1. Installation of J2SDK
2. Write a program to show Scope of Variables
3. Write a program to show Concept of CLASS in JAVA
4. Write a program to show Type Casting in JAVA
5. Write a program to show How Exception Handling is in JAVA
6. Write a Program to show Inheritance
7. Write a program to show Polymorphism
8. Write a program to show Access Specifiers (Public, Private, Protected) in JAVA
9. Write a program to show use and Advantages of CONTRUCTOR
10. Write a program to show Interfacing between two classes
11. Write a program to Add a Class to a Package
12. Write a program to show Life Cycle of a Thread
13. Write a program to demonstrate AWT.
14. Write a program to Hide a Class
15. Write a Program to show Data Base Connectivity Using JAVA
16. Write a Program to show "HELLO JAVA " in Explorer using Applet
17. Write a Program to show Connectivity using JDBC
18. Write a program to demonstrate multithreading using Java.
19. Write a program to demonstrate applet life cycle.

CMA-307 Self Study /GD Seminar

EEA-307	**Self-study /GD Seminar (Internal Assessment)**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

The main Preamble of GD and seminar is to improve the mass communication and convincing / understanding skills of students and it is to give student an opportunity to exercise their rights to express themselves. Evaluation will be done by assigned faculty based on group discussion and power point presentation.

BEA-401 Energy, Ecology, Environment & Society

BEA-401	Energy, Ecology, Environment & Society	2L:1T:0P	3 credits	3Hrs/Week

UNIT-1 Sources of Energy (6 hours): Renewable & Non Renewable, Fossil fuel, Biomass Geothermal, Hydrogen, Solar, Wind, hydal, nuclear sources.

UNIT-2 Segments of Environment (6 hours): Atmosphere, hydrosphere, Lithosphere, biosphere. Cycles in Ecosystem – Water, Carbon, Nitrogen. Biodiversity: Threats and conservation

UNIT-3 Air Pollution (10 hours): Air pollutants, classification, (Primary & secondary Pollutants) Adverse effects of pollutants. Causes of Air pollution chemical, photochemical, Green house effect, ozone layer depletion, acid Rain. Sound Pollution: Causes, controlling measures, measurement of sound pollution (deciblage), Industrial and non – industrial.

UNIT-4 Water Pollution (10 hours): Pollutants in water, adverse effects. Treatment of Domestic & Industrial water effluent. Soil Pollution – Soil Profile, Pollutants in soil, their adverse effects, controlling measures.

UNIT-5 Society, Ethics & Human Values (10 hours): Impact of waste on society. Solid waste management Nuclear, Thermal, Plastic, medical, Agriculture, domestic and e-waste). Ethics and moral values, ethical situations, objectives of ethics and its study . Preliminary studies regarding Environmental Protection Acts , introduction to value education, self exploration, sanyam & swasthya.

References:

1. Harris, CE, Prichard MS, Rabin's MJ, "Engineering Ethics"; Cengage Pub.
2. Rana SVS ; "Essentials of Ecology and Environment"; PHI Pub.
3. Raynold, GW "Ethics in information Technology"; Cengage.
4. Svakumar; Energy Environment & Ethics in society; TMH
5. AK De "Environmental Chemistry"; New Age Int. Publ.
6. BK Sharma, "Environmental Chemistry" ; Goel Publ. House.
7. Bala Krishnamoorthy; "Environmental management"; PHI

SCHOOL OF ENGINEERING

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Undergraduate Degree Courses in Engineering & Technology

Department of Chemical Engineering

CMA-402 Fluid Particle Mechanics

CMA-402	Fluid Particle Mechanics	2L:1T:0P	3 Credits	3Hrs/Week

Course Preambles:

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

Course Outcomes:

Students will be able to

- Calculate drag force and terminal settling velocity for single particles
- Calculate pressure drop in fixed and fluidized beds
- Know the significance and usage of different particulate characterization parameters, and equipment to estimate them
- Describe Size reduction energy requirements, estimate performance of equipment, selection and sizing of equipment.
- Analyse filtration data and select systems based on requirements, estimate filtration area for given requirements, understand filter aids and their usage

Unit-I: Particulate Solid (8 hours): Properties of particulate solids, evaluation of size & shape, shape factor, surface and population of particles, standard screens and screen analysis of solids, screen efficiency, standard screen series.

Unit-II: Size Reduction (8 hours): Principles of communication, size reduction; crushing, grinding, pulverizing and ultra fining size reduction equipments, introduction to nano particles, power requirement in comminution.

Unit-III: Mixing and Separation (12 hours): Mixing of solids, mixing equipment's, design & power requirement of mixers, mixer effectiveness and mixing index. Principles of separation techniques for system involving solids, liquids & gases, classification, sedimentation and filtration, separation equipments, colloidal particles, flocculation and stabilization .

Unit-IV: Transportation and Handling (10 hours): Selection of conveying devices for solids: Belt, Chain, Screw – conveyors, Elevators and pneumatic conveying devices; elementary design aspects of the devices. visit to chemical engineering, industry engaged mainly with mechanical operation.

Unit-V: Fluidization (10 hours): Particulate & aggregative fluidization, characteristic of fluidized bed due to particle size, size distribution, shape and density, pressure drop through a fluidized bed and packed bed, character of dense phase fluidization as revealed by pressure drop fluctuations, up flow and down flow fluidization, fluid catalytic process, bed drying, mass transfer in fluidized beds.

References:

1. Perry RH & Don WG; Perry's Chemical Engineering Hand Book; Mc Graw Hill.
2. Nevers De; Fluid Mechanics for Chemical Engineers; TMH
3. Banchero Badker; Introduction to chemical engg; TMH
4. McCabe S, Harriot ; Unit Operations of Chemical Engg; TMH
5. Narayan CM, Bhattacharya BC; Mechanical operations for chemical eng.; PHI
6. Swain A.K., Hemlata Patra, G.K. Roy , Mechanical operation; TMH
7.

CMA-402	Fluid Particle Mechanics	0L:0T:1P	1 Credits	2Hrs/Week

List of Experiments:

1. To analyses the given sample by differential, cumulative methods using standard screen.
2. Determination of size & surface area of irregular particles using a measuring gauge.
3. To study crushing behavior & to determine the Rittinger's & Bond's constant of the given solid in a jaw crusher.
4. To determine the efficiency of a ball mill for grinding a material of known.
5. To determine the power consumption of the hammer mill.
6. To determine the specific cake resistance for the given slurry by leaf filter.
7. To determine the efficiency of a given cyclone separator.
8. To determine the efficiency of fluidized characteristic bed.
9. To study the Dorr type of thickener.
10. To study the plate & frame filter press.

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CMA-403 Fluid Mechanics

CMA-403	**Fluid Mechanics**	**3L:0T:0P**	**3 Credits**	**3Hrs/Week**

Course Preambles:

- The objective of this course is to introduce the mechanics of fluids (fluid statics and fluid dynamics), relevant to Chemical Engineering operations.
- The course will introduce students to forces on fluids, hydrostatic forces on submerged bodies, Eulerian and Lagrangian descriptions of flow, flow visualization, integral analysis involving mass and momentum balances, Bernoulli equation, flow through pipes and ducts, flow measurement and instruments, flow transportation - pumps, blowers and compressors.

Course Outcomes:

At the end of the laboratory course, students will be able to apply the principles of unit operations through experimentation and will demonstrate the ability to understand the various equipments used in chemical and allied process industry.

Unit-I: Review of Fluid Properties(12 hours): Engineering units of measurement, mass density, specific weight, specific volume, specific gravity, surface tension, capillarity viscosity, bulk modulus of elasticity, pressure & vapor pressure, fluid statics: pressure at a point, pressure variation in static fluid absolute & gauge pressure, manometers, dimensional analysis & dynamic similitude dimensional homogeneity, use of Buckingham pi-theorem, calculation of dimensionless numbers.

Unit-II: Kinematics of Flow (12 hours): Fluid flow phenomena, types of flow-ideal & real, steady & unsteady, uniform & nonuniform, one, two and three dimensional flow, path lines, streak lines, stream lines, stream tubes, continuity equation for one and three dimensional flow, rotational & irrotational flow, boundary layer theory, flow in boundary layer, flow past immersed bodies, packed bed, fluidized bed.

Unit-III: Dynamics of Flow (10 hours): Euler's equation of motion along with a streamline and derivation of Bernoulli's equation, application of Bernoulli's equation, energy correction factor, linear momentum equation for steady flow, momentum correction factor. The moment of momentum equation, forces on fixed and moving vanes and other applications.

Unit-IV: Fluid Measurements and Machines (10 hours): Velocity measurement (Pitot tube, Prandtl tube, current meters etc.) flow measurement (orifices, nozzles, mouth pieces, orifice meter, nozzle meter, venturi-meter, weirs and notches). Pumps, compressor, power & head requirement for pumps, piping system (K Factor), valves and joints.

Unit-V: Fluid Flow (6 hours): Introduction to laminar & turbulent flow, concept of Reynolds number & friction factor; friction factor for rough & smooth pipe loss of head due to friction in pipes & fittings.

References:

1. McCabe Smith;Unit Operation for Chemical Engg. TMH
2. Modi & Seth; Fluid Mechanics; Standard Book House, Delhi
3. Som and Biswas; Fluid Mechnics and machinery; TMH
4. Cengal; Fluid Mechanics; TMH
5. White; Fluid Mechanics; TMH
6. JNIK DAKE; Essential of Engg Hyd; Afrikan Network & Sc Instt. (ANSTI)
7. Douglas; Fluid Mechanics; Pearson
8. R Mohanty; Fluid Mechanics; PHI
9. Gupta; Fluid Mechanics; Pearson.
10. Rajpoot R. K. ;Fluid Mechanics and Hydrolic Machine.
11. Bansal R.K.; Fluid Mechanics and Hydrolic Machine

CMA-403	Fluid Mechanics	0L:0T:1P	1 Credits	2Hrs/Week

List of Experiments:

1. To determine the local point pressure with the help of pitot tube.
2. Calibration of venturimeter.
3. Determination of Cc, Cv, Cd of orifices.
4. Calibration of orifice meter.
5. Calibration of nozzle meter and mouth piece.
6. Reynolds experiment for demonstration of stream lines & turbulent flow.
7. Determination of metacentric height.
8. Determination of friction factor of a pipe.
9. To study the characteristics of a centrifugal pump.
10. Verification of impulse momentum principle.

CMA-404 Fuel Technology

CMA-404	Fuel Technology	3L:0T:0P	3 Credits	3Hrs/Week

Course Preambles:

- To learn the characteristics of coal relevant to its preparation
- To identify the different unit operations used for the preparation of coal for its utilization in thermal power plants and coke ovens
- To get fundamental understanding of operation of industrial coal preparation plants.
- To train personnel in the method and development of fuel cell technology.

Course Outcomes:

- Appreciate the importance of coal and coal preparation for the Indian and global economies
- Understand the construction and operation of crushers and screens used for coal preparation
- Determine the expected yield and quality, and the expected difficulty of beneficiating a coal
- Understand the operation of beneficiation units for coarse coal and fine coal, in Indian context
- Carry out the performance analysis of coal beneficiation equipment
- Get orientation of industrial coal preparation flowsheets**.**

Unit-I: Solid Fuels & Coal Carbonization (10 hours): Coal & lignite reserves in India, classifications of coal, washing of coal, analysis of coal, proximate and ultimate analysis. Mechanism of low temperature carbonization and high temperature carbonization, byproduct recovery from coke oven, properties of coke coal, grinding, pulverization, briquetting of solid fuels.

Unit-II: Liquid Fuels (7 hours): Origin of petroleum production, distillation, thermal & catalytic cracking, coking, reforming, isomerizations, crude oil classification, reserves of hydrocarbon in India, introduction to petroleum refining and processing.

Unit-III: Petroleum Products Properties and Its Utilization (10 hours) : Petroleum product and their utilization, diesel, petrol, blending of petrol for octane number boosting, AVL (aviation liquid fuel), kerosene, fuel & furnace oil, testing of petroleum product: flash point, pore point, fire point, octane number, cetene number, viscosity and viscosity index, API.

Unit-IV: Gaseous fuels (6 hours): Natural gas, synthesis gas, producer gas, water gas, coal gas, LPG, CNG and hydrogen as a fuel, composition properties and uses.

Unit-V: Renewable Energy Sources and Fuel cell (6 hours): Types of solar cell and fabrication, wind energy, principles of tidal energy. Principle and working of fuel cell, various types, construction and its application.

References:

1. Sarkar S; Fuel and Combustion; Orient Long men Ltd.
2. Gupta OP; Fuel and Combustion; Khana Pub
3. Gary ; Refining of Petroleum Techonology
4. D.P. Kothari, K. C. Signal, R. Rajan, Renewable Energy Sources and Emerging technology, PHI Learning pvt. Ltd.
5. G.D. Roy, Non Conventional Energy Source, Khanna Publisher
6. J. Twidel, T Weir, Renewable Energy Sources, Taylor and Francis

CMA-404	Fuel Technology	0L:0T:1P	1 Credits	2Hrs/Week

List of Experiments:

1. To carry on proximate analysis of the given coal sample.
2. To determine the calorific value of the coal by Bomb-Calorimeter method.
3. To determine the viscosity of the given oil sample by Redwood Viscometer. No. 1 and No. 2
4. To determine the viscosity of a given oil sample by Saybolt viscometer.
5. To determine viscosity of a given coal tar with the help of tar viscometer.
6. To determine the flash and fire points of the given oil sample by Penskey Martin'sapparatus..
7. To determine the flash and fire points of the given oil sample by Abel's apparatus.
8. To determine the flash and fire points of the given oil sample by Cleveland apparatus.
9. To determine the carbon residue of the given oil by Conradson method.
10. To determine cloud and pour point of given oil sample (coconut) by cloud and pour point apparatus.

CMA-405 Inorganic Process Technology

CMA-405	Inorganic Process Technology	3L:0T:0P	3 Credits	3Hrs/Week

Course Preambles:
Objective of this subject is to expose students to understand the advancement in chemical process industries and its application to chemical engineering

Course Outcomes:
Students can synthesis production process of the required product.

Unit-I: Salts and Sodium Compounds (08 hours): Salts and sodium compounds, soda ash, caustic soda, chlorine and potassium salts.

Unit-II: Acids (06 hours): Hydrochloric acid, Sulphur and sulfuric acid, Phosphoric acid and phosphates.

Unit-III : Fertilizers (06 hours): Nitrogenous Industries, Ammonia and Nitric acid, Nitrogenous Fertilizer, mixed fertilizers, N-P-K Fertilizers and micronutrients.

Unit-IV: Cement (06 hours): Cement industries, Industrial gases: Nitrogen, Oxygen, Hydrogen, Helium and Argon.

Unit-V: Soaps and Detergents (10 hours): Inorganic chemicals, Bromine, Iodine and Fluorine, soaps and detergents, glass, ceramic and inorganic pigments.

References:

1. Austine G.T.and Shreeves; Chemicasl Process Industries; Mc GrawHill
2. Dryden C.E., M. Gopala Rao; Outlines Of Chemical Technology. Affiliated East-West Press
3. Pandey G.N.; Chemical Technology Volume- I; Lion Press, Kanpur.

CMA-405	Inorganic Process Technology	0L:0T:1P	1 Credits	2Hrs/Week

List of Experiments:

1. To determine the process flow diagram of salts and sodium compounds, soda ash, caustic soda.
2. To determine the process flow diagram of hydrochloric acid, sulphur and sulphuric acid, phosphoric acid and phosphate.
3. To determine the process flow diagram of nitrogenous industries, ammonia and nitric acid, nitrogenous fertilizer.

4. To determine the process flow diagram of cement industries and industrial gases.
5. To determine the process flow diagram of bromine, iodine, Fluorine, soaps and detergents, glass, ceramic and inorganic pigments.

CMA-406 Computer Programming –II

CMA-406	**Computer Programming –II**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

Lab Preamble:

To introduce students

- Basics of software used in Chemical Engineering field
- Computer Aided Process Calculations in chemical field.

Lab Outcomes:

At the end of the lab the students will be able to

- Material Balance solution using Excel.
- Energy Balance Solution Using Excel
- Unit conversions of chemical process.

List of Experiments:

1. Introduction to Microsoft Excel.
2. Basic Operations
3. Using function
4. Unit conversions of chemical process.
5. Material Balance solution using Excel.
6. Energy Balance Solution Using Excel.

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CMA- 407 Industrial Training – I

CMA- 407	**Industrial Training – I**	**0L:0T:0P**	**0 Credits**	**2Hrs/Week**

Preambles:

The following objective should be fulfilled in industrial training –I, and student must participate in any Chemical, Petrochemical, Pharmaceutical, Oil and Gas industry where they can learn to apply the Technical knowledge in real Industrial situations.

Outcomes:

- Gain experience in writing Technical reports/projects.
- Expose students to the engineer's responsibilities and ethics.
- Expose the students to future employers.
- Understand the social, economic and administrative considerations that influence the working environment of industrial organizations.

CMA-501 Heat Transfer

CMA-501	**Heat Transfer**	**2L:1T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles:

• Basic Concepts of Heat Transfer

• Design and Rating of Heat exchangers with and Without Phase Change

• Design and Rating of Compact Heat Exchangers

Course Outcomes:

Students will be able to

• Identify and select type of shell and tube exchanger based on TEMA classification

• Design double pipe heat exchanger, Shell and tube heat exchanger, finned tube and other compact heat exchangers.

Unit-I: Heat Transfer Fundamentals (8 Hours): Modes of heat transfer, thermal diffusivity and heat transfer coefficient; Differential equations of heat transfer.

Unit-II: Conductive heat transfer (8 Hours): One dimensional problems, heat transfer from extended surfaces, two and three dimensional problems, Insulation.

Unit-III: Convective heat transfer (10 Hours): Natural and forced convection; Dimensional analysis; Thermal boundary layer; Analogies and Correlations.

Unit-IV: Design of heat transfer equipment (12 Hours): Double pipe heat exchanger, concept of LMTD, DPHE sizing; shell and tube heat exchanger - Kern's method for design, effectiveness-NTU method, construction aspects in brief, Bell Delaware Method Design aspects of finned tube and other compact heat exchangers.

Unit-V: Basics of Heat transfer with phase change (15 Hours): Introduction to boiling, Introduction to condensation, Design aspects of Condensers, Reboilers and Evaporators, Heat Transfer to Agitated tanks, unsteady state heat transfer, Introduction to Radiative Heat Transfer, Design aspects of Furnaces.

Text / References:

1. R. Welty, C. E. Wicks, R. E. Wilson, G. Rorrer, Fundamentals of Momentum, Heat and Mass Transfer, 4th Ed.,Wiley (2007).
2. W. J. McCabe, J. Smith, P. Harriot, Unit Operations of Chemical Engineering, Sixth Edition, McGraw Hill (2005).
3. Holman, J. P., S. Bhattacharya, Heat Transfer, 10th Ed., Tata McGraw-Hill (2011).
4. D. Q. Kern, Process Heat Transfer, Tata-McGraw Hill (1997).
5. Bejan, A., A. D. Kraus, Heat Transfer Handbook, John Wiley (2003).

CMA-501	Heat Transfer	0L:0T:1P	1 credits	2Hrs/Week

List of Experiment:

1. To determine the thermal conductivity of metal rod.
2. To determine the equivalent thermal conductivity of composite wall.
3. To determine heat transfer coefficient in force convection.
4. To determine heat transfer coefficient in Natural convection.
5. To determine heat transfer coefficient with the help of Stefan Boltzmann Apparatus.
6. To calculate emissivity of the test plate by emissivity measurement apparatus.
7. To determine heat transfer coefficient in double pipe heat exchanger.
8. To study the heat transfer characteristics of a shell and tube heat exchanger (heating/cooling) of water.
9. To determine heat transfer coefficient in parallel and counter flow heat exchanger.
10. To measure the rate of evaporation using an open pan evaporator.
11. To measure the rate of condensation of pure water vapour and to determine the heat Transfer coefficient.
12. Demonstrate the film-wise drop-wise condensation and determination of the heat transfer coefficient.
13. To study the single effect evaporator and find out the heat transfer coefficient.

CMA-502 Mass Transfer-I

CMA-502	**Mass Transfer-I**	**2L:1T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles:

Basic Concepts of Mass Transfer, Staged and Continuous Contact equipment design, gas absorption and distillation

Course Outcomes:

Students will be

• Able to design staged and continuous contactors

• Familiar with special distillation techniques such as steam distillation and azeotropic distillation.

Unit-I: Fundamentals of Mass Transfer(10 Hours): Individual and film coefficients, overall mass transfer coefficient and their inter relationships; Analogies in transfer processes, determination of mass transfer co-efficient; two phase flow in packed beds, co-current and counter current processes flooding loading, column internals: types of trays/ plates and packing, point and plate efficiency.

Unit-II Diffusion phenomenon (10 Hours): Constitutive laws of diffusion unsteady state diffusion, Convective mass transfer, interphase mass transfer, mass transfer correlations, Mass transfer theories/models. Effect of chemical reaction on mass transfer Equilibrium stages and transfer units: number and height of transfer units; stage efficiency.

Unit -III Absorption (08 Hours): Solvent selection for absorption. Material balance and concept of driving force and minimum solvent rates. Gas absorption plate and packed column design; reactive absorption.

Unit-IV: Distillation (06 Hours): Introduction, Batch distillation; continuous binary fractionation, Azeotropic distillation; use of steam.

Unit-V Multistage distillation (10 Hours):: Introduction to multicomponent distillation, McCabe Thiele, and Ponchon-Savarit methods for multistage operations, tray efficiencies, concept of reflux, minimum reflux ratio, optimum reflux, total reflux, Murphree plate efficiencies.

Text / References:

1. Binay K.Dutta, Principles of Mass Transfer and Separation Processes,2nd edition, Prentice Hall of India,2007
2. R.E.Treybal, Mass Transfer Operations, 3rd Edition, McGraw Hill, New Delhi, 1983.
3. E.D. Cussler, Diffusion - Mass Transfer in Fluid Systems, Cambridge University Press, Cambridge 1984.
4. S. Foust, Principles of Unit Operations, 2nd Edition, Wiley, New York, 1980.
5. C.J. Geankoplis, Transport Processes and Unit Operations, 3rd Edition, Prentice Hall, India, 1993.

CMA-502	**Mass Transfer-I**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiment:

1. To study steam distillation
2. To study batch distillation.
3. Studies on packed tower distillation unit.
4. Studies on bubble cap distillation column.
5. To study the absorption of a gas in a packed column and calculation of NTU and HTU.
6. Liquid Diffusion – To calculate the Diffusion Coefficient for a liquid –liquid system
7. To study Solid in air Diffusion
8. Interphase Mass Transfer Coefficient – To calculate the individual and overall Mass Transfer Coefficient.

CMA-503 Chemical Reaction Engineering - I

CMA-503	**Chemical Reaction Engineering - I**	**2L:1T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles:

- Basic Concepts of Kinetics and Rate Laws
- Design and Rating of Ideal Reactors including heat effects
- Interpretation of Rate data
- Design and Rating of Reactors involving multiple reactions including heat effects
- Analysis of Non-ideal flow Behavior in Reactors.

Course Outcomes:

Students will be able to

- Design chemical reactors involving heat effects optimally using minimum amount of data
- Fix some problems related to operability and productivity
- Operate reactors in a safe manner for single and multiple reactions
- Analyze the non-ideality in the reactors

Unit-I: Reactions and reaction rates (10 Hours): Reactions and reaction rates - stoichiometry, extent of reactions, conversion, Selectivity Reaction rate fundamentals - elementary reaction sequences, steady state approximation and rate limiting step theory.

Unit-II Design of ideal reactors (08 Hours): Ideal reactors - generalized material balance, design equations, graphical interpretation, Design of Isothermal and non-isothermal batch, CSTR, PFR, reactors.

Unit -III Sizing and analysis (12 Hours): Sizing and analysis of ideal batch, mixed (CSTR), plug flow and recycle reactors - solving design equations for constant and variable density systems, reactors in series and parallel, Analysis and correlation of experimental kinetic data - data collection & plotting, linearization of rate equations, differential and integral method of analysis.

Unit-IV: Design of reactors for multiple reactions (10 Hours): Multiple reactions - conversion, selectivity, yield, series, parallel, independent and mixed series-parallel reactions.

Unit-V Basics of Non Ideal flow (08 Hours): RTD theory and analysis of non-ideal reactors. RTD Dispersion model, evaluation of RTD characteristics, Tanks in series model, Conversion in non- ideal flow reactors for simple systems.

Text / References:

1. Elements of Chemical Reaction Engineering by H. Scott Fogler, 2nd Edition, Prentice Hall 2001
2. Chemical Reaction Engineering by Octave Levenspiel, 3rd Edition, John Wiley & Sons 2001
3. Smith J.M; Chemical Engineering Kinetics; Mc Graw Hill.
4. Denbigh & Turner K.G; Chemical Reaction Theory An Introduction; United Press.
5. Copper & Jeffery‟s GVJ; Chemical Kinetics And Reactor Engineering; Prentice Hall

CMA-503	Chemical Reaction Engineering - I	0L:0T:1P	1 credits	2Hrs/Week

List of Experiment:

1. To study temperature dependency of rate constant, evaluation of activation energy and Verification of Arrhenius law
2. Study of non-catalytic homogeneous saponification reaction in CSTR.
3. To study a non-catalytic homogeneous reaction in a plug flow reactor.
4. To study the residence time distribution behavior of a back mix reactor.
5. To study the RTD behavior of a tubular reactor.
6. To study the RTD behavior of a packed bed reactor.
7. To study the kinetics of thermal decomposition of calcium carbonate.
8. To study a homogeneous catalytic reaction in a batch reactor under adiabatic conditions.
9. Study of non-catalytic saponification reaction in a tubular flow reactor.

CMA-504 (A) Organic Process Technology

CMA-504 (A)	**Organic Process Technology**	**3L:1T:0P**	**4 credits**	**3Hrs/Week**

Course Preambles:

Objective of this subject is to expose students to understand the advancement in chemical process industries and its application to chemical engineering

Course Outcomes:

Students can synthesis production process of the required product.

Unit-I: Soaps and Detergents (08 Hours): Soaps and detergents, Difference between soaps and detergents, Classification of cleansing compounds, process of soap manufacture, Glycerol recovery, Manufacture of detergents: sulphated fatty alcohols and alkyl – aryl sulphonates.

Unit-II: Indian Sugar Industry (10 Hours): Important features of Indian sugar industry, Major unit operation of sugar industry, Alcohol fermentation, Raw materials for pulp making, Kraft and Sulphite pulping methods, Semi-chemical pulping, chemical recovery, stock preparation and paper making,

Unit-III: Petrochemicals (12 Hours): Important petrochemicals, Feed stock, Common unit processes: cracking, alkylation-dealkylation and hydroalkylation, halogenation, oxidation, hydrogenation-dehydrogenation; hydrationdehydration, nitration, amination, esterification, hydrolysis, hydroformylation process.

Unit-IV: Polymerization Reactions (08 Hours): Basic principles of polymerization reactions: bulk, solution, suspension and emulsion polymerisation, Synthesis of phenol formaldehyde, polyethylene, polystyrene and PVC, Dyes and Dye intermediates, insecticides and pesticides, nitration and nitrating agents.

Unit-V: Fibers (07 Hours): Natural and synthetic fibres, Fibre properties important in textile production, Manufacture of nylon 6,6 and nylon 6 fibres, viscose rayon and polyester fibres, polyamides.

Text / References:

1. Dryden C.E; Outlines Of Chemical Technology; Affilicted. East West press, New Delhi, 1997
2. G.T. Austin, Shreve's Chemical Process Industries, Mc Graw Hill.
3. Gupta VB & Kathari VK; Manufacturing Fibre Technology; Chapman Hall, Newyork I Edition
4. Kathari V.K.; Progress In Textile, Sciences Technology, Vol I & II; IAFL Publications, S-351 Greater Kailash part I New Delhi – 48 I Ed.
5. Austin, G.T; Shreeves Chemical Progress Industries; . Mc. Graw Hill New York

CMA-504 (B) Oil & Paint Technology

CMA-504 (B)	**Oil & Paint Technology**	**3L:1T:0P**	**4 credits**	**3Hrs/Week**

Course Preambles:

Painting companies of every size plan their future development and meet important revenue and profit targets. Painting companies decide where to focus their recruitment programs and their marketing resources.

Course Outcomes:

- To learn the basic ingredients required for paint formulation.
- The ability to understand the various factors to affect the stability of the paint.
- Students should be decided in the situation, and to decide the dosage of various additives in coating formulation.
- Basic knowledge of design paint formulation considering various ingredients.
- The ability to use different machinery and equipment in the laboratory and used on a commercial scale to handle.

Unit-I: Chemistry of Oils (10 Hours): Chemistry of Oils, Fats and Fatty Acids: i. Glycerides, ii. Fatty Acids, iii. Non Glyceride Components of Oils & Fats iv. Chemical Reactions of Fats and Fatty Acids.

Unit-II: Technology and Production of Oils & Fats (12 Hours): Technology and Production of Oils & Fats, Coconut, cotton seed, peanut, palm, sunflower, sesame, softlower, rice fran, rapeseed and mustard seed, linseed, soyabean, tung, casteroil lard and tallow. Minor Oils: Neem Oil and Salfat. a) Mechanical expression of oils, b) Solvent extraction of oilseed and oil bearing material, c) Fat splitting. Refining and Bleaching.

Unit-III: Degumming (10 Hours): Degumming, alkali refining (batch refining), Miscella refining, refining loses – Bleaching by absorption – continuous bleaching.

Unit-IV: Hydrogenation (10 Hours): Hydrogenation, Mechanism – selectivity as applied to the reaction and catalysis, Hydrogenation in practice (Batch & continuous) preparation of Raney Nickel catalyst, Soap manufacture, Raw materials required, selection of raw materials – full boiled process.

Unit-V: Nutritional functions of fats (12 Hours): Nutritional functions of fats, Testing and important analysis of oils and fats in determining the quality and quantity of oils / fats and oilseed; such as moisture, oil content, F.F.A., protein content, color of the raw / refined oil.

Text / References:

1. Feireidoon Shahidi, Bailey's Industrial Oil and Fat Products
2. E. Bernardini, Oils & fats Technology
3. W.M.Morgan, Outlines of Paint Technology
4. V.C.Malshe & Meenal Sikchi, Basics of Paint Technology, Part I & II.

CMA-505 (A) Petroleum Processing Technology

CMA-505 (A)	**Petroleum Processing Technology**	**3L:1T:0P**	**4 credits**	**3Hrs/Week**

Course Preambles:

- An ability to apply acquired knowledge in the area of Petroleum Processing and Petrochemical Engineering
- To understand and know Origin, occurrence, Exploration, Drilling and Production of Crude Oil. Be aware of the challenges involved in refining from viewpoint of product specifications, economic considerations and environmental regulations.
- Provide students with a basic understanding of polymer processing techniques and rheological behavior.
- To understand standard testing methods for the evaluation of different properties.

Course Outcomes:

- An ability of creative thinking, critical analysis, problem solving and decision making specially in research and development
- Know the Origin, occurrence, Exploration, Drilling and Production of Crude Oil.
- Know the composition of crude oil and its products, along with its properties and characterization methods
- Understand the process of fractionation of crude oil and Identify the specifications required for good quality petroleum product

Unit-I: Petroleum Crude (10 Hours): Origin and occurrence of petroleum crude, status of petroleum refining in India; composition of petroleum, classification and physical properties of petroleum.; evolution of crude oil and petroleum products, future refining trends.

Unit-II: Crude Oil Distillation Process (12 Hours): Crude oil distillation process, pretreatment of crude, atmospheric and vacuum distillation process; secondary conversion processes; catalytic reforming, catalytic cracking and deep catalytic cracking.

Unit-III: Polymerization (08 Hours): Heavy residue up-gradation technologies; hydro-cracking, hydro-treating, vis-breaking and delayed coking alkylation, isomerisation, dehydrogenation processes, polymerization.

Unit-IV: Lubricating Oil (10 Hours): Lubricating oil, grease and bitumen: de-waxing and de-oiling, de-asphalting, lube hydro-finishing, bitumen air blowing, sweetening and desulphurization; hydro-desulphurisation of petroleum products.

Unit-IV: Refinery Products (10 Hours): Refinery products, refinery gas utilization, LPG, propylene and hydrogen recovery, reformulated gasoline; present and future requirements.

Text / References:

1. Nelson WL; Petroleum refinery engineering ; Mc. Graw hill
2. Hobson GD; Modern petroleum technology Part I & II; John Wiely & sons.

CMA-505 (B) Conventional & Non-Conventional Energy Sources

CMA-505 (B)	**Conventional & Non-Conventional Energy Sources**	**3L:1T:0P**	**4 credits**	**3Hrs/Week**

Course Preambles:

- Non-conventional resources or renewable resources such as solar energy, wind energy, hydroelectricity, geothermal energy and tidal energy.
- Energy crisis and its solution by using non-conventional sources to maximum extent.

Course Outcomes:

- Understand the different non-conventional sources and the power generation techniques to generate electrical.
- The concept of solar energy and their applications in different fields.
- The ways to harness energy from non-conventional energy sources like geothermal, wind and ocean.

Unit-I: Global and National energy scenario (10 Hours): Global and National energy scenario, Conventional & renewable energy sources, need & development of renewable energy sources, types of renewable energy systems.

Unit-II: Energy and Development (08 Hours): Energy and development role of energy in industrial activity. Contemporary energy crisis, conventional and non-conventional energy sources, energy demand and availability. Energy audit need for energy conservation.

Unit-III: Solar Energy System (10 Hours): Solar energy system, introduction to wind energy conversion, Wind turbines, Wind farms, Bio energy system, design and constructional features.

Unit-IV: Thermal Renewable Energy Systems (12 Hours): Thermal renewable energy systems, appropriate energy technology for rural development, energy conservation, environmental aspects of renewable energy systems.

Unit-V: Energy Conservation (12 Hours): Fluidized bed combustion, Energy conservation in use of heat. Economical design of furnace, water treatment, drying, conditioning and industrial space heating, boiler accessories etc. Heat recovery in waste heat boilers: Conservation, integrated energy systems for industries.

Text / References:

1. Rakosh das begmudre, Energy conservation systems
2. GD Das, Non conventional energy sources
3. S.P. Sukhatme, Solar Energy by Padmashree
4. Harvey A., Dunn J.J, Solid waste Conversionto Energy
5. S. Rao & B.B. Parulka, Energy Technology .

CMA-601 Mass Transfer-II

CMA-601	**Mass Transfer-II**	**2L:1T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles:

To provide students the basic learning and understanding skills towards the problems related to separation & purification and in turn the approach to solve it by applying the concepts/principles learned in the curriculum and to increase the student's ability to apply the principles for the design of Mass Transfer Equipments and their application in process industries.

Course Outcomes:

- Students will be able to
- List situations where liquid–liquid extraction might be preferred to distillation
- Explain the concept of breakthrough in fixed-bed adsorption
- Design cooling towers
- Distinguish among micro-filtration, ultra-filtration, nano-filtration, and reverse osmosis

Unit-I: Liquid-liquid extraction (10 Hours): Liquid-liquid Extraction, Ternary equilibrium. Solvent selection, Single stage, multistage cross-current, counter-current extraction, equipment for liquid-liquid extraction, continuous Contact extraction in packed towers.

Unit-II Solid-Liquid Extraction (12 Hours): Leaching & Washing, Preparation of solids for Leaching, Equilibrium diagrams, ideal stage equilibrium, stage efficiencies, Calculation of single Stage and multi-stage leaching operation.

Unit -III Adsorption (10Hours): Theories of adsorption, types of adsorbent, Isotherms, Break through curves, Stagewise operations, Adsorptions calculations and equipment's, Ion-Exchange; fixed bed absorbers, breakthrough.

Unit-IV: Humidification and Dehumidification (15 Hours): Principles, vapour-liquid equilibria, enthalpy of pure substances, basic definition of all humidification terms, methods of humidification and dehumidification, equipment like cooling towers, tray towers, spray chambers, spray ponds, cooling tower design – HTU, NTU concept, calculation of height of cooling tower.

Unit-V Drying (08 Hours): Drying Equilibria. Drying rate curves. Mechanism of drying. Calculation of batch and continuous drying. Drum dryers, spray and tunnel dryers. Membrane process, Ultrafiltration and Osmosis, Reverse Osmosis.

Text / References:

1. Binay K.Dutta, Principles of Mass Transfer and Separation Processes,2nd edition, Prentice Hall of India,2007
2. R.E.Treybal, Mass Transfer Operations, 3rd Edition, McGraw Hill, New Delhi, 1983.
3. AS. Foust, Principles of Unit Operations, 2nd Edition, Wiley, New York, 1980.
4. W.L. McCabe, J. Smith and P. Harriot, Unit Operations of ChemicalEngineering, 7th Edition, Tata McGraw Hill, India, 2014.
5. C.J. Geankoplis, Transport Processes and Unit Operations, 3rd Edition,Prentice Hall, India, 1993.

CMA-601	Mass Transfer-II	0L:0T:1P	1 credits	2Hrs/Week

List of Experiment:

1. To prepare the drying rate curve for fluidized bed dryer.
2. To study the characteristics of spray dryer.
3. To study the characteristics of drum and Tunnel dryer.
4. To study the drying characteristics of a wet granular material using natural and forced circulation in tray dryer.
5. Tray Dryer – To calculate rate of Drying
6. Rotary Dryer – To study the Characteristics of Rotary Dryer
7. To study the characteristics of cooling tower
8. Humidifier and Dehumidifier – To study the Characteristics
9. Liquid-liquid equilibrium for ternary system
10. Liquid – Liquid Extraction (single stage and multistage)
11. Characterization of Spray Extraction Column

CMA-602 Chemical Reaction Engineering - II

CMA-602	**Chemical Reaction Engineering - II**	**2L:1T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles:

- Basic Concepts of Catalysis
- Kinetics and Mechanistic aspects of Catalysts
- Design and Rating of Catalytic Reactors
- Design Aspects of Gas-Liquid Reactors

Course Outcomes:

Students will be able to

- Design catalytic reactors
- Identify regions of mass transfer control and reaction rate control and calculate conversion

Unit-I: Catalysis (10 Hours): Introduction to Catalysis, homogeneous and heterogeneous catalysis. Preparation and characterisation of catalysts. Physical and chemical adsorption, Adsorption isotherms, Determination of BET surface area and pore volume of the Catalyst. Kinetics of solid catalyzed gas phase reaction.

Unit-II Design of catalytic reactors (12 Hours): Laboratory reactors for catalytic gas solid reactions. Design concepts, Isothermal & adiabatic fixed bad reactor staged adiabatic reactors, Non isothermal, non adiabatic fixed bed reactors.

Unit -III Non-catalytic gas-solid reactions (10 Hours): Non-catalytic gas-solid reactions, different model for gas-solid reactions, Mass transfer, Diffusion and Chemical reactions in catalysts. Effects of external mass transfer and heat transfer, Effectiveness factor. Design aspects of catalytic reactors.

Unit-IV: Gas liquid reactions (12 Hours): Gas liquid reactions, film and penetration theories, enhancement factor in gas-liquid reactions, gas-liquid reactors, Reaction design for instantaneous reactions and slow reactions.

Unit-V External transport processes (15 Hours): External transport processes and their effects on heterogeneous reactions yield and selectivity Reaction and diffusion in porous catalysts, Isothermal and non-isothermal effectiveness factors, Effect of intra-phase transport on yield, selectivity & poisoning, Global reaction rate.

Text / References:

6. Elements of Chemical Reaction Engineering by H. Scott Fogler, 2nd Edition, Prentice Hall 2001
7. Chemical Reaction Engineering by Octave Levenspiel, 3rd Edition, John Wiley & Sons 2001
8. Chemical and Catalytic Reaction Engineering, Carberry, J. J., Dover Books on Chemistry, 2001.
9. Chemical Reactor Analysis and Design Gilbert F. Froment, Kenneth B. Bischoff, Juray De Wilde, John Wiley & Sons, Incorporated, 2010

CMA-602	Chemical Reaction Engineering -II	0L:0T:1P	1 credits	2Hrs/Week

List of Experiment:

1. To determine the order and rate constant of saponification reaction at room temperature.
2. To determine the order and rate constant of esterification reaction at room temperature .
3. To study homogeneous catalytic reaction in a batch reactor under adiabatic conditions.
4. To study the rate constant of hydrolysis of an ester-catalyzed by acid.
5. Determine the rate constant and order of reaction between Potassium per sulphate and Potassium iodide
6. To study temperature dependency of rate constant, evaluation of activation energy and Verification of Arrhenius law
7. To study a homogeneous reaction in a semi-batch reactor under isothermal conditions.
8. Study of non-catalytic homogeneous saponification reaction in CSTR.
9. To study a non-catalytic homogeneous reaction in a plug flow reactor.
10. To study the residence time distribution behavior of a back mix reactor.

CMA-603 (A) Transport Phenomena

CMA-603 (A)	**Transport Phenomena**	**3L:1T:0P**	**4 credits**	**3Hrs/Week**

Course Preambles:

- This course will highlight coupling between three transport phenomena with applications in various disciplines in engineering and science, and will demonstrate to the students the common mathematical structure of transport problems.
- The course will deal with flow problems involving Newtonian and non-Newtonian fluids, solid-state heat conduction, forced and free convection, binary diffusion with or without chemical reaction.

Course Outcomes:

On completion of the course, students would be familiar with

- Basics of vector and tensor analysis
- Be able to solve transport problems using shell balances
- Formulate and solve one-dimensional transport problems by using the conservation equations
- Formulate simple multi-dimensional transport problems

Unit-I: Introduction (10 Hours): Introduction to Transport Phenomena, Formulation of transport problems from nature, Vector and Tensor Analysis: Basic concepts.

Unit-II: Basics of momentum transport (08 Hours): Basics of momentum transport: Euler/Lagrangian viewpoint, laminar and turbulent flows, boundary layers, stress tensor.

Unit-III: Shell Momentum Balances (10 Hours): Shell momentum balances, equations of change, dimensional analysis, applications to isothermal flow of Newtonian & non-Newtonian fluids.

Unit-IV: Basics of energy transport (12 Hours): Basics of energy transport, conductive, convective and viscous dissipation energy fluxes, Equations of change for non-isothermal systems, dimensional analysis, and applications to steady-state conduction and convection, Basics of mass transport, mechanisms, and mass and molar fluxes.

Unit-V: Unsteady-State Momentum (10 Hours): Derivation of equation of continuity for a binary mixture and its application to convection-diffusion problems, Unsteady-state

momentum, heat and mass transport, formulation of basic equations and similarity transform method.

Text / References:

1. R. B. Bird, W. E. Stewart, and E. S. Lightfoot. Transport Phenomena, 2nd ed., Wiley India Pvt. Ltd., 2002.
2. Welty, C. E. Wicks, R. E. Wilson, and G. L. Rorrer. Fundamentals of Momentum, Heat, and Mass Transfer. 5th ed., Wiley India Pvt. Ltd., 2007.
3. W. M. Deen, Analysis of Transport Phenomena, Oxford University Press, 1998.
4. W. J. Thompson, Introduction to Transport Phenomena, Prentice Hall, 2000.

CMA-603 (B) Bio Chemical Engineering

CMA-603 (B)	Bio Chemical Engineering	3L:1T:0P	4 credits	3Hrs/Week

Course Preambles:

1. To introduce the essential concepts of bioprocessing to traditional chemical engineers.
2. To make the student aware about advances in Biotechnology.
3. The Program encourages students to work in the field of biotechnology.

Course Outcomes:

The students will gain an ability to apply knowledge of mathematics, bioscience, and engineering. Students will learn to apply the principles of biology, engineering science, along with problem-solving skills and critical thinking to a broad spectrum of problems in biotechnology.

Unit-I: Introduction to Bioscience (10 Hours): Types of Microorganisms: Structure and function of microbial cells. Fundamentals of microbial growth, batch and continuous culture. Isolation and purification of Enzymes from cells. Assay of Enzymes. Functioning of cells and Fundamental Molecular.

Unit-II: Biology (12 Hours): Metabolism and bio-energetics, Photosynthesis, carbon metabolism, EMP pathway, tricarbocyclic cycle and electron transport chain, aerobic and anaerobic metabolic pathways. Synthesis and regulation of bimolecular, fundamentals of microbial genetics, role of RNA and DNA.

Unit-III: Enzyme Technology and Kinetics (10 Hours): Applications of enzymes in industry and medicine. Immobilization of enzymes, Kinetics of enzyme catalytic reactions involving isolated enzymes, Reversible inhibition. Reactions Catalysed By Enzymes.

Unit-IV: Reactors Analysis (10 Hours): Reactor Design and Analysis for soluble enzyme systems. Cofactor regeneration, Membrane reactor. Effect of mass transfer in immobilised enzyme particle systems. Reactors for immobilised enzyme systems. Bio Reactors, Effect of Transport Processes.

Unit-V: Introduction to Bioreactor design (12 Hours): Continuously Stirred aerated tank bioreactors. Mixing power correlation .Determination of volumetric mass transfer rate of oxygen from air bubbles and effect of mechanical mixing and aeration on oxygen transfer rate, heat transfer and power consumption. Multiphase bioreactors and their applications. Downstream processing and product recovery in bioprocesses.

Text / References:

1. J. E. Bailey and D. F. Ollis, Biochemical Engineering Fundamentals.
2. Trevan, Boffey, Goulding and Stanbury, Biotechnology.
3. M. L. Shuler and F. Kargi, Bio Process Engineering: Basic concepts.
4. Inamdar S.T.A, Biochemical Engineering – Principles and Concepts.

CMA-604 (A) Environmental Pollution & Pollution Control

CMA-604 (A)	**Environmental Pollution & Pollution Control**	**3L:0T:0P**	**4 credits**	**3Hrs/Week**

Course Preambles:

The Pollution Control and the protection of the environmental quality with sustainable development The practice also helps in stopping pollution of water due to reduction in discharges of waste into water bodies and the receiving body.

Course Outcomes:

- Describe the effects of water pollution on aquatic ecosystems.
- Describe the effects of air pollution on the environment and on human health
- Describe the effects of water pollution on human health
- Describe some key principles that support pollution prevention and control

Unit-I: Environment (10 Hours): Interaction of man and environment, overall picture of environmental pollution, environmental air and water quality criteria, standards and acts, effects of pollution.

Unit-II: Air Pollution (12 Hours): dispersion of pollutant in the atmosphere, meteorological factors of air, stability and inversion of atmosphere, control of air pollution, air pollution control equipments. Methods of measuring and sampling of gaseous and particulate pollutants in ambient air and industrial waste gases.

Unit-III: Water Pollution (10 Hours): Sources, types of pollutants in liquid wastes of chemical industries, methods for the treatment of liquid wastes to control pollution, selection of pollution control equipment, Methods of sampling of waste water, Odour and its control.

Unit-IV: Solid Waste Disposal (12 Hours): Characterization of solid wastes, problems of collection and handling, various processing techniques used in solid waste management, solid waste as resource material,

Unit-V: Noise pollution (06 Hours): Noise pollution: noise control criteria, noise exposure index, Control.

Text / References:

1. C. S .Rao, Environment Pollution Control and Environmental Engg.
2. Peavy and Row, Environmental Engineering.
3. A.C. Stern, Air Pollution – Engg. Control of Air Pollution Vol IV.
4. J. O .M. Bockris, Environmental Chemistry.

CMA-604 (B) Fertilizer Technology

CMA-604 (B)	Fertilizer Technology	3L:0T:0P	4 credits	3Hrs/Week

Course Preambles:

- Provide exposure to Nitrogenous and Complex fertilizer production technologies.
- Overview to the most recent Nitrogenous fertilizer production technologies.
- Improve participants' technical knowledge over a varied range of fertilizer production techniques, understanding the best available technology options with cost effective, minimal energy consumption along with the best approaches to safety and environmental management.

Course Outcomes:

- Use reactions and unit operations steps in manufacturing of various fertilizers
- Characterize fertilizers on the basis of different properties.
- Identify engineering problems in fertilizer manufacturing.

Unit-I: Introduction (10 Hours): Introduction, Plant nutrients, different types of fertilizers and their production in India.

Unit-II: Nitrogenous Fertilizers (10 Hours): Different feed stocks, Synthesis gas production by steam-naptha reforming and gas purefication. Ammonia synthesis. Urea manufacturing processes. Manufacture of sulphuric acid and ammonium sulphate. Nitric acid and ammonium nitrate manufacture.

Unit-III: Phosphatic Fertilizers (12 Hours): Availability and grinding of rock phosphate, manufacturing processes for single and triple super- phosphate and phosphoric acid. Mixed Fertilizers: Availability and manufacture of muriate of potash.

Unit-IV: Mixed Fertilizers: (10 Hours): Mixed Fertilizers: Mono and di-ammonium phosphate, urea ammonium phosphates, NPK complex fertilizers, granulation techniques.

Unit-V: Engineering Problems (08 Hours): Fertilizers storage and handling. Corrosion problems in fertilizers industries. Fertilizer plant effluent treatment and disposal.

Text / References:

1. Slack A.V, Chemistry and Technology of Fertilizers.
2. Austin G.T., and Shreve's, Chemical Processes Industries.
3. Waggaman W.H., Phosphoric Acid, Phosphates and Phosphatic Ferilizers.
4. Rao M.G. and Sittig M Dryden's, Outlines of Chemical Technology.

CMA-605 (A) Nano Technology in Catalysis

CMA-605 (A)	Nano Technology in Catalysis	3L:1T:0P	4 credits	3Hrs/Week

Course Preambles:

- To give exposure to various types of equipment.
- Handing the instruments related to the separation process.
- Designing the experiments

Course Outcomes:

Synthesis of various nanoparticles are performed and their themal property using analytical equipments are done.

Unit-I: Introduction (10 Hours): Introduction to Nanotechnology, Physical chemistry of solid surfaces: Electrostatic stabilization, steric stabilization. Synthesis of Nanomaterials: Matrix mediated growth technique, the sol-gel method, Chemical precipitation method etc,

Unit-II: Methods of Synthesis (08 Hours): Methods of synthesis of nanomaterial's fabrication-Top-down vs. bottom-up‖ approaches. Equipment and processes needed to fabricate nanodevices and structures.

Unit-III: Fundamental of Catalysis (10 Hours): Fundamental understanding of catalysis at nano-scale. Wet chemical synthesis, preparation and properties of iron, platinum, gold, cadmium, silver, copper and nickel nano-particles.

Unit-IV: Application in Chemical Technology (12 Hours): Synthesis and properties of composite nano-particles and coated nano-particles. Application in Chemical Technology: Polymer Nano composites-Synthesis, characterization, mechanical, thermal properties etc.

Unit-V: Characterization (10 Hours): Characterization of nano particles by Scanning probe microscopes (Atomic Force Microscopy, Scanning Tunneling Microscopy), Transmission Electron Microscopy, Scanning Electron Microscopy.

Text / References:

1. Nanotechnology: Principles and Practices, . S. K. Kulkarni .
2. Nano science and technology: novel structures and phenomena, Tang, Zikang and Sheng, Ping, Taylor and Francis,

3. Nanotechnology: Understanding small systems B. Rogers, S. Pennathur, J. Adams Nanotechnology in Catalysis Pinzhan.
4. Jurgen Schulte, Nanotechnology (strategies, industry trends, and applications, Willey, 1st Edition, England 2005.

CMA-605 (B) Fluidization Engineering

CMA-605 (B)	Fluidization Engineering	3L:1T:0P	4 credits	3Hrs/Week

Course Preambles:

- To study the fluidization phenomena, fluidized bed regimes and models.
- Investigate effect of the size and density of spherical particles on the minimum fluidization velocity. At least three different particle sizes and three different densities should be considered.
- Investigate effect of fluid properties on the fluidization process by comparing air- and water-based fluidized beds.

Course Outcomes:

- Understand the fluidization phenomena and operational regimes.
- Design various types of gas distributors for fluidized beds and determine effectiveness of gas mixing at the bottom region.
- Analyze fluidized bed behavior with respect to the gas velocity.
- Develop and solve mathematical models of the fluidized bed.

Unit-I: Introduction (10 Hours): The phenomenon of fluidization; liquid like behaviour of a fluidized bed; Comparison with other contacting methods; Advantages and disadvantages of fluidized beds. Industrial applications of fluidized beds.

Unit-II: Coal gasification (12 Hours): Coal gasification; gasoline from other petroleum fractions; Gasoline from natural and synthesis gases; Heat exchange; Coating of metal objects with plastics; Drying of solids; Synthesis of phthalic anhydride; Acrylonitrile; Polymerization of olefins; FCCU; Fluidized combustion of coal; incineration of solid waste; Activation of carbon; gasification of waste; bio-fluidization.

Unit-III: Fluidization and Mapping of Regimes (10 Hours): Minimum fluidization velocity; Pressure drop vs. velocity diagram; effect of temperature and pressure on fluidization; Geldart

classification of particles; terminal velocity of particles; turbulent fluidization; pneumatic transport of solids; fast fluidization; solid circulation systems;

Unit-IV: Bubbling Fluidized Beds (12 Hours): Bubbling Fluidized beds: Experimental findings; Estimation of bed porosities; Physical models: simple two phase model; K-L model.High velocity Fluidization: Turbulent fluidized bed; Fast fluidization pressure drop in turbulent and fast fluidization. Solids Movement, Mixing, Segregation and staging: Vertical movement of solids.

Unit-V: Horizontal Movement of Solids (15 Hours): Horizontal movement of solids; Staging of fluidized beds.Gas Dispersion and Gas interchange in Bubbling Beds: Dispersion of gas in beds; Gas interchange between bubble and emulsion; Estimation of gas interchange coefficients. Particle to Gas Mass Transfer: Experimental interpolation of mass transfer coefficients; Heat transfer; Experimental heat transfer from the bubbling bed model.

Text / References:

1. Fluidization Engineering Kunil, Diazo and Octave Levenspiel Fluidization Max Leva.
2. Fluidization Engineering O. Levenspiel and D. Kunii,
3. Gas-Liquid-Solid Fluidization Engineering Liang-Shih Fan,

CMA-701 Process Control

CMA-701	Process Control	3L:0T:0P	3 credits	3Hrs/Week

Course Preambles:

Objective is to introduce the fundamentals of process control with applications using P, PI, and PID controllers. The course will teach the students about mathematical models based on transfer function approach for single loop systems, how to obtain dynamic response of open loop and closed loop systems, stability analysis in transient and frequency domains, and controller tuning methods. The course would end with more advanced concepts like feed-forward control, ratio control, model-predictive control, ratio control, dead-time compensation, etc.

Course Outcomes:

Students will be able to

- Understand the importance of process dynamics (unsteady state operation)
- Tune a controller to reject disturbances or manage operating point transitions

Unit-I: Introductory Concepts (10 Hours): Need for control and automation, control logic, servo and regulatory control, block diagrams, control structures (feedback vs. feedforward), process and instrumentation diagrams.

Unit-II: Laplace transforms (10 Hours): Laplace transforms solution of ODEs using Laplace transform, Transfer function approach, response of first order systems: step, impulse and sinusoidal response, first order systems in series.

Unit-III: Second order systems (12 Hours): Second order systems, higher order systems, transportation lag and dead time, Linear closed loop systems, development of block diagrams, classical feedback controllers, Final control element such as Proportional, Integral, PD, PID controllers (control valves), block diagram reduction techniques.

Unit-IV: Closed loop response (12 Hours): Closed loop response, servo and regulatory problems, Stability analysis, Routh stability criterion, Root locus diagrams (rule based), Introduction to frequency response, notion of stability.

Unit-V: Bode diagrams (10 Hours): Bode diagrams, Nyquist plots, Bode and Nyquist stability criterion, Controller tuning: Ziegler-Nichols method, Cohen-Coon method, Introduction to advanced controllers: cascade control, feed forward control, ratio control, Smith-predictor, IMC, MPC, dead-time compensation, Introduction to digital control.

Text / References:

1. Coughanowr, D. R., LeBlanc, S. "Process Systems Analysis and Control", 3rd edition, McGraw-Hill (2008).
2. Seborg, D.E., Edgar, T.F., Mellichamp, D.A. "Process Dynamics and Control", 2nd edition, John Wiley (2003)
3. Stephanopoulos, G. "Chemical Process Control: An Introduction to Theory and Practice", Pearson Education (1984)

CMA-701	Process Control	0L:0T:1P	1 credits	2Hrs/Week

List of Experiment:

1. To study the characteristics of control valves (linear, quick opening, etc)
2. To study the dynamics of liquid level systems of non-interacting and interacting types.
3. To study the response of mercury in glass thermometer with and without a thermowell.
4. To study the characteristics of an electronic PID controller.
5. To study the characteristics of a current to pneumatic converter.
6. To study the effectiveness of computer control of a distillation column.
7. To study the effectiveness of a computer control of a heat exchanger.
8. To study to effectiveness of a computer control of a chemical reactor
9. To study to dynamics of a pressure tanks.
10. To calibrate an air purged liquid level indicator.

CMA-702 Numerical Method in Chemical Engineering

CMA-702	Numerical Method in Chemical Engineering	3L:0T:0P	3 credits	3Hrs/Week

Course Preambles:

To introduce students to numerical methods used to solve engineering problems, in particular chemical engineering problems, using numerical methods and computer programming. Fundamentals of numerical methods/algorithms to solve systems of different mathematical equations (e.g. linear/ non-linear algebraic equations, ordinary /partial differential equations), will be introduced. The course would enable students to write their own computer programs using programming languages like C and commercial software like Matlab. Hands-on experience will be provided to apply these computer programs to solve problems in different areas of chemical engineering e.g. fluid flow, heat and mass transfer, chemical reaction engineering etc. Practicals to involved solving actual chemical engineering problems through computer programming and coding.

Course Outcomes:

Students will be able to solve chemical engineering problems involving

- Linear and non-linear equations
- Ordinary and partial differential equations using programming languages like C and softwares like MATLAB.

Unit-I: Introduction Error & Linear Algebraic Equations (12 Hours): Introduction, Approximation and Concept of Error & Error Analysis, Linear Algebraic Equations: Methods like Gauss elimination, LU decomposition and matrix inversion, Gauss-Siedel method, Chemical engineering problems involving solution of linear algebraic equations.

Unit-II: Non-Linear Algebraic Equations (10 Hours): Root finding methods for solution on non-linear algebraic equations: Bisection, Newton-Raphson and Secant methods, Chemical engineering problems involving solution of non-linear equations.

Unit-III: Interpolation (10 Hours): Interpolation and Approximation, Newton's polynomials and Lagrange polynomials, spline interpolation, linear regression, polynomial regression, least square regression.

Unit-IV: Numerical integration (10 Hours): Numerical integration, Trapezoidal rule, Simpson's rule, integration with unequal segments, quadrature methods, Chemical engineering problems involving numerical differentiation and integration.

Unit-V: Ordinary Differential Equations (15 Hours): Ordinary Differential Equations, Euler method, Runge-Kutta method, Adaptive Runge-Kutta method, Initial and boundary value problems, Chemical engineering problems involving single, and a system of ODEs, **Introduction to Partial Differential Equations:** Characterization of PDEs, Laplace equation, Heat conduction/diffusion equations, explicit, implicit, Crank-Nicholson method.

Text / References:

1. Gupta, S. K., "Numerical Methods for Engineers, New Academic Science, 2012.
2. S.C. Chapra & R.P. Canale, "Numerical Methods for Engineers with Personal Computer Applications", McGraw Hill Book Company, 1985.
3. R.L. Burden & J. D. Faires, "Numerical Analysis", 7th Ed., Brooks Coles, 2000.
4. Atkinson, K. E., "An Introduction to Numerical Analysis", John Wiley & Sons, 1978.
5. Press, W. H. et al., "Numerical Recipes in C: The Art of Scientific Computing, 3rd Edition, Cambridge University Press, 2007.

CMA-702	Numerical Method in Chemical Engineering	0L:0T:1P	1 credits	2Hrs/Week

List of Experiment:

1. Introduction to use of computers for numerical calculations (1 practical turn)
2. Solution of linear algebraic equations using Gauss elimination, Gauss-Siedel etc. (2 practical turns)
3. Solution of a non-linear equations using bracketing and Newton-Raphson method (2 practical turns)
4. Interpolation and Approximation(2 practical turns)
5. Numerical integration(2 practical turns)
6. Euler method (1 practical turn)
7. Runge-Kutta methods for ODEs (2 practical turns)
8. Solution of system of ODEs using simple methods (1 practical turn)
9. Solution of simple PDEs (2 practical turns)

CMA-703 (A) Polymer Technology

CMA-703 (A)	**Polymer Technology**	**3L:0T:0P**	**4 credits**	**3Hrs/Week**

Course Preambles:

- To study industrial manufacturing process advantages disadvantages, process parameters of the thermoplastics like PVC Cellulosics Speciality polymers etc
- To give understanding of properties like physical mechanical thermal rheological etc and structure properties and relationship
- To make aware of practical applications of thermoplastics.
- To study basic processing methods coating applications related to of the thermoplastics

Course Outcomes:

- Explain central concepts within the fields of polymer physics and polymer technology
- Describe phenomena in terms of properties of polymer systems at molecular level
- Describe the relationship between microscopic and macroscopic levels for polymer systems
- Solve simple polymer-related problems arising in industrial contexts

Unit-I: Polymerization Chemistry (10 Hours): Chain, step and miscellaneous polymerization reactions and polymerization technique. Polymerization kinetics: Free radical, cationic and anionic polymerization, poly-condensation and polymerization.

Unit-II: Polymerization Processes (10 Hours): Bulk solution, emulsion and suspension polymerization, thermoplastic composites, fiber reinforcement fillers, surface treatment reinforced thermo-set composites resins, fillers, additives.

Unit-III: Polymer Reactions (12 Hours): Hydrolysis, acidolysis, aminolysis, hydrogenation, addition and substitution reactions, reactions of various specific groups, cyclyzation and cross linking reactions, reactions leading to graft and block copolymer

Unit-IV: Manufacturing Processes of Polymers (12 Hours): Manufacturing processes of important polymers: Plastics- polyethylene, polypropylene polyvinyl chloride & copolymer, polystyrene; Phenol-formaldehyde, epoxides, urethane, Teflon, elastomers, robbers, polymeric oils - silicon fibers - cellulosic (Rayon), polyamides (6:6 Nylon), Polyesters (Dacron). Acrylic-olefin.

Unit-V: Composite Materials (12 Hours): Composite materials - Ceramic and other fiber reinforced plastics, Polymer degradation - Thermal, Mechanical, Ultrasonic, Photo, High energy radiation, Ecology and environmental aspects of polymer industries. Rheological Sciences Equations, Uni-coelastic models - Maxwell.

Text / References:

1. Rodringuez; Principles of polymer systems; TMH
2. Billmayer Jr, Fred W.; Textbook of polymer science; Wiley tappon
3. David J Williams; Polymer science & engineering; PHI
4. Mc. Keley, JH; Polymer processing; John Wiley

SCHOOL OF ENGINEERING

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Undergraduate Degree Courses in Engineering & Technology

Department of Chemical Engineering

CMA-703 (B) Multi-Phase Flow

CMA-703 (B)	**Multi-Phase Flow**	**3L:0T:0P**	**4 credits**	**3Hrs/Week**

Course Preambles:

- The fallout of the multiphase flows is focused on: oil and gas industry, nuclear components and subsystems, chemical and petrochemical industry.
- Multiphase flow is important in many areas of chemical and process engineering. The behaviour of the material will depend on the properties of the components, the flow rates, and the geometry of the system.

Course Outcomes:

- Develops as the flow rate is increased whilst vapor flow is maintained at a low amount.
- Two phase flows are commonly found in ordinary life and in industrial processes.
- Gas-liquid flow also occurs in boiling and condensation operations.

Unit-I: Introduction (10 Hours): Introduction to the flow of multiphase mixtures: gas or vapor liquid, liquid-liquid, liquid-solid, gas-solid, solid-liquid-gas and gases carrying solids (pneumatic transport) stratification and dispersion, Flow regimes and flow patterns.

Unit-II: Gas (Vapor) and Liquid Flows (10 Hours): Horizontal flow, Vertical flow, pressure, momentum and energy relations, methods of evaluating pressure drop, Lockhard - Martinell, Chisholm correlations, critical flow, non-Newtonian flow.

Unit-III: Physical-Chemical Properties (12 Hours): Physical, chemical properties, rheology, corrosive nature, viscosity, Solid particle size, distribution phase, and density i.e. their factors effecting behavior in a fluid, Concentration of particles and the flow rates of both solids and liquid.

Unit-IV: Solid-Gas Flow (12 Hours): Horizontal flow, Suspension mechanism, determination of voids, energy requirements for conveying, pressure drop and solid velocities in dilute phase flow, dense phase conveying, vertical transport.

Unit-V: Bubble and Drop Formation (10 Hours): Phase holdups, Interfacial areas, mixing and pressure drops, multiphase (gas liquid solid) operations.

Text / References:

1. The flow of complex mixtures in pipe Govier, G.W. and Aziz, K
2. Chemical engineering, Vol I, Coulson JM and Richardson J.F
3. Multiphase Flow Handbook Crowe, C.T.
4. Fundamentals of Multiphase Flow Brennen, C.E

CMA-704 (A) Food Technology

CMA-704 (A)	Food Technology	3L:0T:0P	4 credits	3Hrs/Week

Course Preambles:

- Knowledge and understanding of food properties, processing and preparation and their interrelationship to produce quality food
- Knowledge and understanding of nutrition and food consumption, and the consequences of food choices on health.

Course Outcomes:

- Demonstrates hygienic and safe practices in the selection, handling and storage of food.
- Recognises the relationship between food properties, preparation and processing.
- Recognises the nutritional value of food items, recognises the impact of food habits and choices on health.

Unit-I: Introduction (06 Hours): Current status of the Indian a) agriculture b) Food Industry c) Food processing industry.

Unit-II: Basic Food Biochemistry and Microbiology (12 Hours): Food Constituents, Water activity enzymes, Ambient Temperature Processing: Raw material preparation, Size reduction of solid fibrous foods and in liquid foods, Emulsification and Homogenization, Theory and equipment, Mixing and Forming, Extraction and expression,

Unit-III: Membrane Concentration Fermentation (10 Hours): Membrane concentration Fermentation: Theory, Types, Equipment Effect on foods.

Unit-IV: Heat Processing using Heat or Water (10 Hours): Theory, Equipment, Effect on foods, blanching, extrusion, pasteurization, Heat Sterilization, In-container Ultra high temperature

(UHT)/aseptic processes. Heat processing using Hot air: Theory, Equipment, Effect on foods, Dehydration, Baking and Roasting; Heat Processing using hot oils: Theory, Equipment, Effect on foods Frying.

Unit-V: Heat Processing by Direct & Radiated Energy: (12 Hours): Heat Processing by direct & radiated energy: Theory, Equipment, Effect on foods Dielectric heating microwave. Processing by removal of heat, Food Preservation & Storage Food contamination Modified Atmosphere Storage (MAS) Hurdle Technology, Post Processing, Applications, and Packaging**.**

Text / References:

1. Vijaya khader, Preservation of Fruits and Vegetables.
2. Viyaya khader, Food Processing and Preservation.
3. Srilakshmi. B, Food science, (2nd edition) & Food science & Nutrition.
4. Swaminathan. M, Essentials of Food and Nutrition , Vol. I & II.

SCHOOL OF ENGINEERING

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Undergraduate Degree Courses in Engineering & Technology

Department of Chemical Engineering

CMA-704 (B)Optimization Methods

CMA-704 (B)	Optimization Methods	3L:0T:0P	4 credits	3Hrs/Week

Course Preambles:

- To understand the basics of optimization techniques, and problem formulation for optimization
- To understand the single variable and multivariable optimization techniques and their application
- To understand the linear programming application for optimization
- To understand the advance optimization technique like the genetic algorithm

Course Outcomes:

- The students will understand the necessary and sufficient condition for optimization and will be able to formulate the optimization problem.
- The students will be able to solve different optimization problem and their application to the case studies like heat exchanger, evaporator etc.

Unit-I: Nature and Organization of Optimization Problems (10 Hours): What optimization is all about, Why optimize, scope and hierarchy of optimization, examples of applications of optimization, the essential features of optimization problems, the general procedure for solving optimization problems, obstacles to optimization.

Unit-II: Basic Concepts of Optimization (10 Hours): Continuity of functions, unimodal versus Multimodel functions. Convex and Concave functions, Convex region, Necessary and sufficient conditions for an extremum of an unconstrained function, interpretation of the objective function in terms of its quadratic approximation.

Unit-III: Optimization of Unconstrained Functions (12 Hours): One-dimensional search: Numerical methods for optimizing a function of one variable, scanning and bracketing procedures, Newton's, Quasi-Newton's and Secant methods of uni-dimensional search, region elimination methods, polynomial approximation methods, how the one- dimensional search is applied in a multi-dimensional problem, evaluation of uni-dimensional search methods.

Unit-IV: Unconstrained Multivariable Optimization (15 Hours): Direct methods, random search, grid search, uni-variate search, simplex method, conjugate search directions, Powell's method, indirect methods- first order, gradient method, conjugate method, indirect method-second order: Newton's method forcing the Hessian matrix to be positive definite, movement in the search direction, termination, summary of Newton's method, relation between conjugate gradient methods and Quasi-Newton method.

Unit-V: Linear Programming and Applications (12 Hours): Basic concepts in linear programming, Degenerate LP's – graphical solution, natural occurrence of linear constraints, the simplex method of solving linear programming problems, Optimization of Unit operations, recovery of waste heat, shell & tube heat exchangers, evaporator design, liquid-liquid extraction process, optimal design of staged distillation column.

Text / References:

1. Edgar, T.F., D.M. Himmelblau, and L.S. Lasdon, Optimization of Chemical Processes, 2nd Edition, McGraw-Hill International Edition, Singapore, 2001.
2. Rao, S.S., Engineering Optimization Theory and Practice, 4th Edition, A Wiley Interscience Publication, Canada, 2009.
3. Reklaitis, G.V., A. Ravindran, and K.M. Ragsdell, Engineering Optimization: Methods and Applications, 2 nd Edition, John Wiley, New York, 2006.
4. Fletcher R., Practical method of optimization, 2 nd Edition, John Wiley, New York, 2000.
5. Chong E.K.P. and Zal S. H., An Introduction to optimization, 2 nd Edition, John Wiley, New York, 2001.
6. Nocedal J. and Wright S.J. Numerical Optimization, 2 nd Edition, Springer,2000.
7. G. Mitsuo and C. Runwei, Genetic Algorithms and Engineering Optimization, John Wiley, New York, 2000.

CMA-705 Project Stage-I

CMA-705	**Project Stage-I (Minor)**	**0L:0T:10P**	**5 credits**	**20Hrs/Week**

Preambles:

The following objective should be fulfilled in industrial training–II, and student must participate in any Chemical, Petrochemical, Pharmaceutical, Oil and Gas industry where they can learn to apply the Technical knowledge in real Industrial situations.

- Gain experience in writing Technical reports/projects.
- Expose students to the engineer's responsibilities and ethics.
- Expose the students to future employers.
- Understand the social, economic and administrative considerations that influence the
- Working environment of industrial organizations.

CMA-801 Chemical Process Modeling and Simulation

CMA-801	Chemical Process Modeling and Simulation	3L:0T:0P	3 credits	3Hrs/Week

Course Preambles:

- To understand knowledge of fundamental principles and basic laws of modeling
- To understand the approach for mass/heat transfer & CRE
- To apply the knowledge of differential equations
- To understand the approach to modeling
- Formulation of a mathematical model for various chemical Engg. System.

Course Outcomes:

Students are able to model every Chemical Engineering system assigned to them. Moreover, they could make the program of the model equation to get output results and analyzed the performance of the system.

Unit-I: Introduction (07 Hours): Introduction, Uses of mathematical models, Scope of coverage, Principles of formulations, Introduction of Matlab and use of the language to solve modeling problems.

Unit-II: Mathematical Modeling in Chemical Reaction Engineering (15 Hours): Mathematical Modeling in Chemical Reaction Engineering: CSTR, PFR, Batch reactor, semibatch reactor, Series of isothermal CSTR, constant hold-up CSTR's, CSTR's with variable hold ups, gas phase pressurized CSTR, non isothermal CSTR, Bioreactor, trikle bed reactor. Simulation, program development and numerical solutions of above processes.

Unit-III Mathematical Modeling in Mass Transfer (15 Hours): Mathematical Modeling in Mass Transfer: Ideal binary distillation column, multicomponent non ideal distillation column, batch distillation with hold up, steam distillation, Multisolute batch liquid- liquid extraction, continuous extraction, multistage countercurrent extraction, plug flow type liquid- liquid extraction, reactor with mass transfer, Absorption, Adsorption. Simulation, program development and numerical solutions of above processes.

Unit-IV: Mathematical Modeling in Heat transfer (10 Hours): Mathematical Modeling in Heat transfer: Two heated tanks, single component vaporizer, double pipe heat exchanger, shell and tube heat exchanger, multicomponent flash drum, cooling towers. Simulation, program development and numerical solutions of above processes.

Unit-III: Mathematical Modeling in other chemical processes (12 Hours): Mathematical Modeling in other chemical processes: Interacting and non-interacting systems with and without heaters, isothermal hydraulic system, forward and backward feed triple effect evaporator, melting, batch reverse osmosis Unit, Real CSTR modeled with an exchange volume, Real CSTR modeled using by passing and dead space, Two CSTR's with interchange. Simulation, program development and numerical solutions of above processes.

Text / References:

1. Process Optimization in Chemical Engineering by Edger Himmelblau.
2. Lubyen W. L., Process Modeling, Simulation and Control for Chemical Engineers, McGraw- Hill, New York, 1989.
3. Elements of Chemical Reaction Engineering by Fogler, Prentice Hall of India.
4. Mickley H. S., Sherwood T. S., Reed C. E., Application of Mathematical Modeling in Chemical Engineering, Tata-McGraw-Hill, New Delhi, 2002.
5. A. Kayode Coker, Modelling of Chemical Kinetics and Reactor Design, Gulf professional publication

CMA-801	**Chemical Process Modeling and Simulation**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiment:

1. Modeling and simulation of Chemical reaction processes
2. Modeling and simulation of mass transfer processes
3. Modeling and simulation of heat transfer processes
4. Modeling and simulation of fluidized process
5. Modeling and simulation of flash evaporator
6. Modeling and simulation of linear and non linear systems

CMA-802 (A) Chemical Process Equipment Design

CMA-802 (A)	**Chemical Process Equipment Design**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles:

- Provide students with a basic understanding equipment design.
- To teach students the design of pressure vessel.
- To teach students the design of the storage vessel.
- To teach students to apply the design concepts in practical industrial design problem.

Course Outcomes:

After completion of this course, the students will be able to do the design of industrial pressure vessel and storage vessel.

Unit-I: Importance of Chemical Process Equipment Design (10 Hours): Importance of chemical process equipment design, the design procedure for pressure vessels subjected to internal pressure, and combined loading, closures for pressure vessels, Code and standards for pressure vessels (IS:2825:1969), materials of construction, selection of corrosion allowance and weld joint efficiency.

Unit-II: Design of Pressure Vessels (08 Hours): Design of pressure vessels subjected to high pressure, monoblock construction, shrink fit construction, external pressure, optimum proportions of pressure vessels, optimum sizing of vessels.

Unit-III: Design of Supports (07 Hours): Design of supports, flanges, nozzles for vessels, Design of jackets, coils for pressure vessels.

Unit-IV: Mechanical Design of Storage Tanks (10 Hours): Mechanical design of storage tanks for volatile and non-volatile liquids, roof and bottom design, optimum proportions of the storage tank, storage tanks for solids and its design procedure, Design of cylindrical storage vessel.

Unit-V: Heat Exchangers Design (12Hours): Codes and standards for heat exchangers; Baffles; Tie-rods; Tube joining methods; Design of shell and tube heat exchangers, design of single effect evaporator, Design of distillation column, absorption column, and reactors.

Text / References:

1. Process equipment dsign-vessel design by Lloyd E. Brownell and Edwin Young, John Wiley, NewYork 1963.
2. Chemical Engineering Volume 6 – Design by J.M. Coulson, J.F. Richardson and R. K. Sinnott, Pergamon press International Edition 1989.
3. Introduction to chemical equipment design – Mechanical Aspects by B.C. Bhattacharyya, CBS Publications.
4. Process Equipment Design by M.V. Joshi and V.V. Mahajani Macmillan India
5. Pressure Vessel Hand book by Eugene F. Megyesy, Pressure vessel company, USA.
6. Design of machine elements by V.B. Bhandari, McGraw Hill.

CMA-802 (B) Novel Separation Technology

CMA-802 (B)	Novel Separation Technology	3L:0T:0P	3 credits	3Hrs/Week

Course Preambles:

- The objective of this subject is to expose students to understand advance separation technique for separation and its application to chemical engineering.
- To train students on advanced separation processes, thermodynamics of separation operations and equilibrium-based design methods.

Course Outcomes:

- To built advanced concepts of separation techniques used in chemical industries.
- To understand the principles and functioning advanced separation techniques.
- To understand the applications of advanced separation techniques as per industrial requirement..
- To recognize the selection criteria between advanced separation techniques and conventional separation techniques.

Unit-I: Separation Techniques (10 Hours): Limitations of common separation techniques – sedimentation, screening, filtration, evaporation, distillation, absorption, liquid-liquid and solid-liquid extraction. Principles of membrane separation process classification, characterization and preparation of membrane.

Unit-II: Analysis and Modeling of Membrane Separation (12 Hours): Analysis and modeling of membrane separation, Membrane modules and application. Reverse Osmosis and ultra-filtration, membrane characteristics and applications, Ion- selective membranes and their application in electrolysis.

Unit-III: Vaporization and Gas Separation (12 Hours): Vaporization and gas separation using membranes, Liquid membrane, Industrial applications. Liquid membrane separation, critical extraction, pressure swing adsorption and freeze drying, pervaporation and permeation, nano-separation. Foam and bubble separation, principle, classification, foam and surfactants, Separation techniques, Column Separations.

Unit-IV: Multi-Component Separation (10 Hours): Multi-component separation, Zone melting and Zone refining, electrophoresis, desalting by freezing, centrifugation.

Unit-V: Parametric Pumping (07 Hours): Parametric pumping, thermal parametric pumping, batch, continuous pumping, pH-parametric pumping, heatless parametric pumping.

Text / References:

1. Seader J. D. and Henley E. J., Separation Process Principles.
2. Suresh S, Keshav, A Textbook of Separation Processes.
3. King C. J, Separation Processes.
4. Arden T. V., Water Purification By Ion-exchange.

CMA-803 (A) Safety and Risk Analysis

CMA-803 (A)	**Safety and Risk Analysis**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles:

- To give knowledge of process plant safety, hazardous chemicals, fire and explosion hazards and different methods of hazard identification and its analysis in qualitative and quantitative scales.
- The students will introduce to personnel safety and case study problems.
- To develop the social, ethical and environmental responsibility among the students.
- To develop the safety concepts among the students with a detailed understanding of technical knowledge.
- To develop the responsibility and ability for precautions and remedial actions for any untoward event.

Course Outcomes:

At the end of the course, the student Students will gain knowledge of safety standards to be maintained at process industries and handling of problems related to safety, different methods of hazard identification and their analysis.

Unit-I: Introduction (12Hours): Introduction to process plant safety, handling of hazardous chemicals, Lower flammability limit (LFL), UFL, LEL, UEL, TLV, electrostatic hazards, Hazard code and explosive limit, TWA, Ceiling level, Safety in handling of gases, liquids and solids, Flammable liquid hazards, fire and explosion index, fireball hazards, oil spillage hazards, Bleveuvce, pool fires, jet fires, radiation hazards.

Unit-II: Fires and Explosions (18 Hours): The Fire Triangle, Distinction between Fires and Explosions, Definitions, Flammability Characteristics of Liquids and Vapors, Liquids, Gases and Vapors , Vapor Mixtures, Flammability Limit Dependence on Temperature and pressure, Estimating Flammability Limits, Limiting Oxygen Concentration and Inerting, Flammability Diagram, Ignition Energy, Autoignition, Auto-Oxidation, Adiabatic Compression, Ignition Sources, Method Energy of Chemical Explosions, Energy of Mechanical Explosions, Missile Damage Blast Damage to People, Vapor Cloud Explosions, Boiling-Liquid Expanding-Vapor Explosions.

Unit-III: Toxicology (12Hours): Toxic materials and their properties, effect of dose and exposure time, relationship and predictive models for response, Threshold value and its definitions, material safety data sheets, industrial hygiene evaluation.

Unit-IV: Risk Assessment (10 Hours): Review of Probability Theory, Interactions between Process Units, Revealed and Unrevealed Failures, Probability of Coincidence , Redundancy, Common Mode Failures, Event Trees, Fault Trees, Advantages and Disadvantages of Fault Trees, Relationship between Fault Trees and Event Trees.

Unit-V: Resources for Combating Fires (10 Hours): Resources for combating fires, dry chemical powders, firefighting foam, fixed and portable fire extinguishers, OSHA standards, the importance of plant layout in safety, the importance of site selection, personal safety, the role of human error in losses. Case studies of fires, explosions, disasters in chemical process plants.

Text / References:

1. Crawl D.A. and Louvar J.A, Chemical process safety fundamentals with applications.
2. Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl and Joseph F. Louvar, Prentice Hall International Series, 2 nd Edition
3. Safe and Efficient Plant Operation and Maintenance, Greene R., McGraw Hill Book Co., New York.
4. Safety Management and Practices for Hazardous Units, Dekkar Marcel, McGraw Hill Book Co., New York, 1995
5. Safety and Good House Keeping, Saxena, National Productivity Council, New Delhi (1976), 3rd Edition.
6. Safety in Process Plant Design, Wells G.L., George Godwin Ltd., (1980).

CMA-803 (B) Petrochemical Technology

CMA-803 (B)	**Petrochemical Technology**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Course Preambles:

To learn properties, application and production techniques of various Petrochemicals and to understand scientific and technological principles of organic synthesis and related unit processes.

Course Outcomes:

- An ability to apply acquired knowledge in the area of Petroleum Processing and Petrochemical Engineering
- Familiarize and understand various unit processes in synthesis of various Petrochemicals, with the present and emerging feed stock scenario and resource constraints
- Understand and remember various properties and applications of second and third generation petrochemicals.
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Unit-I: Introduction (10 Hours): Chemicals from methane and synthetic gas: Ammonia, Methanol and Hydrogen Cyanide.

Unit-II: Chemicals from Olefins (08 Hours): Ethylene derivatives, Propylene derivatives and Butylenes derivatives, Chemical from Aromatics**,** synthetic fibres, Plastics and rubber.

Unit-III: Conversion (08 Hours): Conversion of - Ethylene to ethylene oxide, ethylene glycol, ethanol amine Propylene to acrylic acid ,methyl ethyl ketone acrylonitrile**.**

Unit-IV: Conversion of Butane (08 Hours): Conversions of – Butanes to isobutene and n butanols, MIBK, MTBE Aromatics to maleic and phathalicanhydride, DMT, phenols and acetones Cyclohexane to caprolactum, adipic acid.

Unit-V: Hydration (10 Hours): Technologies for production of alcohols such as ethanol, isobutyl alcohol and higher alcohols, Esterification: Process for production of few esters such as acrylates, terephthalates, ester for flavoring industries.

Text / References:

1. Mall, I D, Petrochemical Process Technology.
2. Bhaskar Rao, Modern Petroleum Refining Processes.
3. Speight J, Chemistry & Technology of Petroleum.
4. Robert Mayer, Handbook of Petroleum Refining Processing.
5. N.N. Lebdev, Chemistry and technology of basic organic and petrochemical synthesis.
6. B.K. Bhaskarrao, A text on Petrochemicals, 2nd Ed, Khanna publishers, New Delhi.
7. G.N. Sarkar, Advanced Petrochemicals, 1st Ed, Khanna Publishers, New Delhi.

CMA-804 Project Stage-II

CMA-804	**Project Stage-II (Major)**	**0L:0T:16P**	**8 credits**	**32Hrs/Week**

Preambles:

The focus of the Industrial Training Project-II is on preparing a working system or some design or Understanding of a complex system using system analysis tools and submit it the same in the form of a write up i.e. detail project report. The student should select some real life problems for their project and maintain proper documentation of different stages of project such as need analysis market analysis, concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan. Each student is required to prepare a project report and present the same at the final examination with a demonstration of the working system (if any).

SCHOOL OF ENGINEERING

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Undergraduate Degree Courses in Engineering & Technology

Department of Chemical Engineering

MANDATORY COURSES

Sr. No.	Course Code	Course Title	Credits	Preferred Semesters
1	MC	[Environmental Sciences, Induction Program, NSS/NCC] Constitution of India	Nil	I, III, IV,
		Total		0

Induction Program

MC	Induction Program	0L:0T:0P	Nil	2Hrs/Week

Induction program (mandatory)	3 weeks duration (Please refer Appendix-A for guidelines & also details available in the curriculum of Mandatory courses)
Induction program for students to be offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

A student has to undergo this induction program after joining the institute and before the commencement of classes. Normal classes of the engineering program shall begin after the students have undergone a three-weeks induction program. The Induction program for students comprises of Physical activities; Learning an art form; Literature & Cinema; Social Awareness; Lectures &Visits; Universal Human Values; Familiarization to Department/ Branch, College& Innovations.

Constitution of India

MC	**Constitution of India**	**0L:0T:0P**	**Nil**	**2Hrs/Week**

Unit 1 Introduction

Concept of liberty; Concept of positive and negative obligations

Unit 2 The Premises of Social Revolution: Intellectual and historical origins of the concept of Social Economic Justice in India.

Unit 3 Sixty years of civil rights movement in India:

Moderate nationalism and the emergence of the politics of socio-economic justice; Annie Besant, the Theosophical Society and the Home Rule League Movement,

Unit 4 Impact of Socialism on the Writing of the Indian Constitution [I], [1914-31]:

From the First World War to the Karachi Resolution: [a] Jawaharlal Nehru's arrival in national politics and his initiation in municipal politics; [b] The Bolshevik Revolution [1917] and its impact on growth of Indian socialism; [c] Growth and influence of Fabian socialists on Indian nationalism; [d] Commonwealth of India Bill [1925]; [e] National Demand or the Motilal Nehru Report [1927-8] and the Calcutta Congress [1928]; [f] Karachi Resolution of the Indian National Congress [1931]

Unit 5 Impact of Socialism on the Writing of the Indian Constitution [II], [1932-52]:

From the Demand for Adult Suffrage to Passing of the Constitution of India: [a] Growth of the Congress Socialist Party and the demand for the adoption of adult suffrage; [b] Panchayati Raj and empowerment in the Indian Constitution; [c] The National Plan [1938], the Bombay Plan [1944] and proposals for large-scale industrialisation in India; [d] The August Offer [1940], Cripps Mission [1942] and the Cabinet Mission proposals [1946]; [e] The establishment of Indian Constituent Assembly [1946], the Indian Independence Act [1947], the working of the

Constituent Assembly and the Assembly debates and the role of the Oligarchy comprising of Jawahaharlal Nehru, Vallabhbhai Patel, Maulana Abul Kalam Azad and Rajendra Prasad in it; [f] Social reforms and State Security v. 'Due Process of Law'; [g] The introduction, passage and development of the Hindu Code Bill, 1956

References:

1. Bagehot, Walter, An Introduction to English Legal History, [London, 1990]
2. Berlin, Isaiah, Henry Hardy and Ian Harris, Liberty: Incorporating Four Essays on Liberty, [Oxford, 2002]
3. Austin, Granville, The Indian Constitution: Cornerstone of a Nation, [Oxford, 1966] –, Working of a Democratic Constitution: A History of the Indian Experience, [New Delhi, 2003]
4. Bagchi, Amiya Kumar, Private Investment in India, 1900-1939, [London, 1972]
5. Bakshi, P.M., The Constitution of India: With Comments and Subject Index, [Delhi, 1991]
6. Basu, Durgadas, Introduction to the Constitution of India, [New Delhi, 1995] –, Shorter Constitution of India, [Calcutta, 1959]
7. Chandra, Bipan, [et al.], India's Struggle for Independence, [New Delhi, 1991]
8. Coupland, Reginald, The Indian Problem, Three Volumes, [London, 1944]
9. Dutta, Nilanjan, 'From Subject to Citizen: Towards a History of Indian Civil Rights Movement', in Michael Anderson and Sumit Guha, Changing Concepts of Rights and Justice in South Asia, [New Delhi, 2000]
10. Dhavan, Rajeev and Thomas Paul, Nehru and the Constitution, [Bombay, 1992]
11. Forbes, Geraldine, Women in India, [Cambridge, 1996] Gauba, O.P., Constitutionalism in a Changing Perspective, [New Delhi, 1996]
12. Mohanty, Manoranjan, 'Does India Need a New Constitution? [A Democratic Right Perspective on Constitutional Discourse]', in Surya Narayan Misra, Subhas Chandra Hazary and Amareshwar Misra, [ed.], Constitution and Constitutionalism in India, [New Delhi, 1999]

(11) Assessment

PO/Course Assesment Tools Types	PO/Course Assesment Tools	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12
		Engineering Knowledge	Problem Analysis	Design/Development of Solution	Investigation	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Team Work	Communication	Project Management	Life-Long Learning
Direct Tools	Test	*	*	*	*				*		*	*	
	Assignments	*	*			*				*			
	lab /seminar/industrial training/projects(Rubrics)	*	*	*		*		*	*	*	*	*	*
Indirect Tools	Course end survey	*				*		*					
	Exit survey	*	*										*
	Faculty Survey		*	*	*			*					
	Alumni Survey	*			*		*		*	*	*		*
	Program Statistics	*			*				*			*	