NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Education

Ethics

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(ESTABLISHED BY MINISTRY OF HUMAN RESOURCE DEVELOPMENT, GOVT. OF INDIA)

In GOD's own land, a fusion of scholastic students, innovative & motivated researchers & teachers and fast moving visionary leaders.

Steeping Stone and Sky reaching ladder to success

COURSE STRUCTURE & SYLLABUS FOR B-TECH IN CHEMICAL ENGINEERING

Research

PO-Yupia,Dist.–PapumPare, Arunachal Pradesh,Pin–791112
PhNo:0360-2284801/2001582
FaxNo:0360-2284972
Email–nitarunachal@gmail.com

Service to Society

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Prof. (Dr.) Chandan Tilak Bhunia, Ph.D [Engg.], FIETE, FIE(I), SMIEEE

DIRECTOR

FORWARD

To **achieve the target of being a global leader in the field of Technical Education**, there is some sort of time bound urgency **to work quickly, massively and strongly**, in respect of National Institute of Technology, Arunachal Pradesh being an **" Institute of National Importance"** (by an Act of Parliament) and being **established only in five years back in 2010**. I have therefore adopted a **'B' plan** as stated below to achieve the primary goal of producing world class visionary Engineers and Exceptionally brilliant Researchers and Innovators:

B- Plan

➢ **Best Teaching**
➢ **Best Research**
➢ **Best Entrepreneurship & Innovation practices**
➢ **Best Services to Society**

In implementing the **'B' plan** in letter and spirit, the framing of syllabi has been taken **as important legitimate parameter**. Therefore, extraordinary **efforts and dedications were directed for the last few years to frame** a syllabus **in a framework perhaps not available in the country as of today, and with Indian perspective with Global context**.

Besides attention on **'B' plan** institute has given considerable importance to the major **faults of current Technical Education while framing the syllabus**. The major stumbling blocks in Technical Education today are:

I. The **present system is producing "Academic Engineers" rather than "Practical Engineers".**
II. The present system of education makes the **students to run after jobs rather than making them competent to create jobs.**
III. There is lack of **initiative to implement the reality of "Imagination is more important than knowledge".**

Taking due consideration of the findings made above, to my mind credible syllabi has been framed in the institute in which the major innovations are introduction of:

I. **I-Course (Industrial Course) one in each semester at least one, which is targeted to be taught by the Industrial Expert at least up to 50% of its component.**

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
Syllabus for B-Tech (chemical engineering)

II. **Man making and service to society oriented compulsory credit courses of NCC/NSS, values & ethics.**
III. **Compulsory audit course on Entrepreneurship for all branches.**
IV. **Many add-on courses that are (non-credit courses) to be offered in vacation to enhance the employability of the students.**
V. **Many audit courses like French, German, and Chinese to enhance the communication skill in global scale for the students.**
VI. **Research and imagination building courses such as Research Paper Communication.**
VII. **Design Course as "Creative Design".**

Further, the syllabus is framed **not to fit in a given structure as we believe structure is for syllabus and syllabus is not for structure. Therefore, as per requirement of the courses, the structure, the credit and the contact hours has been made available** in case to case.

The syllabus is also innovative as it includes:

I. **In addition to the list of text and reference books, a list of journals and magazines for giving students a flexibility of open learning.**
II. **System of examination in each course is conventional examination, open book examination and online examination.**

Each course has been framed with definite objectives and learning outcomes. Syllabus has also identified the courses to be taught either of two models of teaching:

I. **J. C. Bose model of teaching where practice is the first theory.**
II. **S. N. Bose model of teaching where theory is the first practice.**

Besides the National Institute of Technology, Arunachal Pradesh has initiated a scheme of **simple and best teaching** in which for example:

I. **Instead of teaching RL, RC and RLC circuit separately, only RLC circuit will be taught and with given conditions on RLC circuits, RL and RC circuits will be derived and left to the students as interest building exercise.**
II. **Instead of teaching separately High Pass Filter, Band Pass Filter and Low Pass Filter etc.; one circuit will be taught to derive out other circuits, on conditions by the students.**

I am firmly confident that the framed syllabus will result in **incredible achievements, accelerated growth and pretty emphatic win over any other systems** and therefore **my students will not run after jobs rather jobs will run after.**

For the framing of this excellent piece of syllabus, **I like to congratulate all members of faculty, Deans and HODs in no other terms but "Sabaash!"**

Prof. Dr. C.T. Bhunia
Director,
NIT, (A.P.)

****

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

GUIDELINES

In order to achieve the desired goal of excellence and innovations in each and every function of National Institute of Technology, Arunachal Pradesh and to implement 'B' Plan in totality, I call upon my distinguished members of Faculty to invest some of their valuable business time in doing Research on Teaching. In this context, I put forward the following general guidelines for teaching practices in the institute:

1) **J.C. Bose Model of Teaching:** As an example, In the Basic Electronics course instead of first teaching the colour codes of the resistors in a theoretical class, teacher may carry few resistors to class and note down on the blackboard the colours of resistors and their values. Thereafter, the teacher may ask the students to device the colour code creating enthusiasm among students. Similarly, instead of teaching the characteristics of PN junction diode, teacher may guide the students in a laboratory to draw the characteristics curve, then may advise the students to analyse the behaviour of characteristics. Thereafter, the teacher may teach the theory of PN junction diode.

2) **S.N. Bose Model of Teaching:** This is the conventional model of teaching where theory is first practice but even then I suggest some unique ideas to improve imaginative power and creativity of students in the subject. For example, instead of teaching two algorithms for conversion of decimal to binary, one for integral part and another for fractional part, I call upon the teachers to design a single algorithm for both the purposes for inspiring teaching.

3) I also believe that noble teaching **will be simple and in simpler way.** Therefore, I call upon the teachers not to teach band pass filter, low pass filter, high pass filter separately. Teachers may design a single circuit for all filters and put on condition thereon can derive separately circuits for separate filters. Similarly, instead of teaching RL, RC and RLC circuits separately, I call upon the teachers to teach only RLC circuit and then putting suitable condition on RLC circuit; RL and RC circuits may be derived and taught.

4) **Last but not the least,** I call upon the teachers to **solve all the problems of all chapters of the main text book prescribed for a subject** in a teaching-learning process – 50% to be solved by teachers (may be of even ones) and 50% may be solved by students (may be odd ones).

I solicit and anticipate full cooperation from all my brilliant pool of young and energetic faculty members to practice the nobel and novel teaching procedures explained above without fail. Once **procedures implemented by teachers are documented,** we may proceed to file a patent on **Research in Teaching on behalf of NIT, Arunachal Pradesh.**

Prof. Dr. C.T. Bhunia
Director,
NIT, (A.P.)

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

Syllabus for B-Tech (chemical engineering)

SEMESTER – I

Subject Code	Subject	Model	P	L	T	Credit
MAS - 101	Engineering Mathematics – I	S.N Bose	0	3	1	4
CHY - 101	Engineering Chemistry	S.N Bose	2	3	0	4
PHY - 101	Engineering Physics – I	S.N Bose	2	3	0	4
BIO - 101	Life Science	S.N Bose	0	3	0	3
CE - 101	Engineering Drawing	J.C Bose	3	0	0	2
ME - 101	Engineering Mechanics	S.N Bose	0	3	0	3
ME - 102	Workshop Practice	J.C Bose	3	0	0	2
EE - 101	Basic Electrical & Electronics Engineering	J.C Bose	2	3	0	4
HSS - 101	Communication Skill	S.N Bose	2	0	0	1
HSS - 102	NSS/NCC	J.C Bose	2	0	0	1
HSS - 103	Foreign Language (French / Korean) (Audit)	J.C Bose	2	0	0	0
			18	18	1	28

SEMESTER – II

Subject Code	Subject	Model	P	T	L	Credit
MAS - 201	Engineering Mathematics – II	S.N Bose	0	1	3	4
ME - 201	Basic Elements of Mechanical Engineering	S.N Bose	0	0	3	3
CSE - 201	Programming in C	J.C Bose	8	0	0	4
CHY - 201	Environmental Science	J.C Bose	0	0	3	3
PHY - 201	Engineering Physics II	S.N Bose	2	0	3	4
ECE - 201	Digital Electronics & Logic Design	J.C Bose	2	0	3	4
HSS - 201	Historiography of Science & Technology	J.C Bose	0	0	3	3
HSS - 202	Foreign Language (French) (Audit)	J.C Bose	2	0	0	0
CE - 201	Basic Civil Engineering	J.C Bose	0	0	3	3
ME - 202	Workshop Practice II	J.C Bose	3	0	0	2
			17	1	21	30

SEMESTER – III

Subject Code	Subject	P	T	L	Credit
CHE - 301	Chemical Engineering Thermodynamics	0	1	3	4
CHE - 302	Fluid Mechanics	0	0	3	3
CSE 302	Data Structure & Algorithm	2	0	3	4
CHE - 303	Physical Chemistry	0	0	3	3
MAS - 301	Discrete Mathematics	0	1	3	4
HSS - 301	Behavioral Science	0	0	2	2
CHE - 304	Instrumental Analysis	3	0	0	3
CHE - 305	Numerical Methods in Chemical Engineering	0	1	3	4
HSS - 302	Yoga	2	0	0	1
		7	**3**	**20**	**28**

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

SEMESTER - IV

Subject Code	Subject	P	T	L	Credit
CHE - 401	Chemical process Technology - I	0	0	3	3
CHE - 402	Mechanical Operation	0	1	3	4
CHE - 403	Heat Transfer	0	1	3	4
MAS - 401	Stochastic Processes	0	1	3	4
CHE - 404	Process Control	0	1	3	4
CHE - 405	Fuel and Combustion	0	0	3	3
CHE - 406	Numerical Methods Laboratory	3	0	0	3
CHE - 407	Fluid Mechanics Laboratory	3	0	0	3
		6	**4**	**18**	**28**

SEMESTER – V

Subject code	Subject	P	T	L	Credit
CHE - 501	Mass Transfer – I	0	1	3	4
CHE - 502	Chemical Reaction Engineering – I	0	1	3	4
CHE - 503	Process Instrumentation	0	0	3	3
CHE - 504	Chemical Process Calculations	0	1	3	4
CHE - 505	Chemical Process Technology – II	0	0	3	3
CHE - 506	Heat Transfer Laboratory	3	0	0	3
CHE - 507	Mechanical Operation Laboratory	3	0	0	3
CHE - 508	Fuel Technology Laboratory	3	0	0	3
		9	**3**	**15**	**27**

SEMESTER – VI

Subject code	Subject	P	T	L	Credit
CHE - 601	Mass Transfer – II	0	1	3	4
CHE - 602	Chemical Reaction Engineering – II	0	1	3	4
HSS - 601	Engineering Ethics & IPR	0	0	3	3
CHE - 603	Process Equipment Design – I	2	0	3	4
CHE - 606X	Elective - I	0	0	3	3
CHE - 607X	Elective - II	0	0	3	3
CHE - 604	Instrumentation & Control Lab.	3	0	0	3
CHE - 605	Reaction Engineering Lab.	3	0	0	3
		8	**2**	**18**	**27**

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

Syllabus for B-Tech (chemical engineering)

SEMESTER - VII

Subject code	Subject	P	T	L	Credit
CHE - 701	Creative Design	4	0	0	4
HSS - 401	Entrepreneurship & Innovation for Practices	0	0	3	3
HSS - 703	Industrial Economics	0	0	3	3
HSS - 501	Industrial Management	0	0	3	3
CHE - 702	Transport Phenomena	0	0	3	3
CHE - 703	Process Equipment Designs-II	1	0	3	4
CHE - 704	Project Work	6	0	0	6
CHE - 705	Seminar	2	0	0	2
CHE - 706	Mass Transfer - II Lab.	3	0	0	3
		16	**0**	**15**	**31**

SEMESTER - VIII

Subject code	Subject	P	T	L	Credit
CHE - 801X	Elective - III	0	0	3	3
CHE - 802X	Elective - IV	0	0	3	3
CHE - 803	Project Work	12	0	0	6
CHE - 804	In-Plant Training	2	0	0	1
CHE - 805	Grand Viva	12	0	0	6
		26	**0**	**6**	**19**

List of Electives I

Subject code	Subject	P	T	L	Credit
CHE - 606A	Petroleum Refining & Petrochemicals	0	0	3	3
CHE - 606B	Energy Engineering	0	0	3	3
CHE - 606C	Pollution Control in Process Industries	0	0	3	3

List of Electives II

Subject code	Subject	P	T	L	Credit
CHE - 607A	Nuclear Energy	0	0	3	3
CHE - 607B	Pulp and Paper Technology	0	0	3	3
CHE - 607C	Chemical Plant Safety and Occupational Hazard	0	0	3	3
CHE - 607D	Power Plant Engineering	0	0	3	3

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

List of Electives III

Subject code	Subject	P	T	L	Credit
CHE - 801A	Nanotechnology	0	0	3	3
CHE - 801B	Polymer Technology	0	0	3	3
CHE - 801C	Frontiers of Chemical Engineering	0	0	3	3
CHE - 801D	Membrane Technology	0	0	3	3
CHE - 801E	Transport Processes I - Heat and Mass Transfer	0	0	0	3

List of Electives IV

Subject code	Subject	P	T	L	Credit
CHE - 802A	Colloid and Interface Science and Engineering	0	0	3	3
CHE - 802B	Biochemical Engineering	0	0	3	3
CHE - 802C	Material Technology	0	0	3	3
CHE - 802D	Food Technology	0	0	3	3
CHE - 802E	Environmental Quality Monitoring and Analysis	0	0	3	3

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Name of the Module: Engineering Mathematics - I
Module Code: MAS - 101
Semester: 1ˢᵗ
Credit Value: 4 [P=0, T=1, L=3]

A. Objectives:
The course is designed to meet with the objectives of:
1. Providing high quality education in pure and applied mathematics in order to prepare students for graduate studies or professional careers in mathematical sciences and related fields.
2. Imparting theoretical knowledge and to develop computing skill to the students in the area of Science and Technology.
3. Providing teaching and learning to make the students competent to their calculating ability, logical ability and decision making ability.
4. Giving students theoretical knowledge of Calculus, Algebra and their practical applications in the various fields of Science and Engineering.
5. Apply their knowledge in modern industry or teaching, or secure acceptance in high-quality graduate programs in Mathematics and other fields such as the field of quantitative/Mathematical finance, Mathematical computing, statistics and actuarial science.

B. Learning Outcomes:
Students successfully completing this module will be able to:
1. Students will become more confident about their computing skill, logical skill and decision making skill.
2. Students will find various applications of Calculus and Algebra in the practical fields science and engineering.
3. Students will become more competent to analyze mathematical and statistical problems, precisely define the key terms, and draw clear and reasonable conclusions.
4. Student will be able to use mathematical and statistical techniques to solve well defined problems and present their mathematical work, both in oral and written format, to various audiences (students, mathematicians, and non-mathematicians).
5. Student will be able to understand, and construct correct mathematical and statistical proofs and use the library and electronic data-bases to locate information on mathematical problems.
6. Student will be able to explain the importance of Mathematics and its techniques to solve real life problems and provide the limitations of such techniques and the validity of the results.
7. Student will be able to propose new mathematical and statistical questions and suggest possible software packages and/or computer programming to find solutions to these questions.

C. Subject Matter:
  Unit I:
Matrices: Introduction to Matrices and their basic properties, Transpose of a matrix, verification of the properties of transposes, Symmetric and Skew symmetric matrices and their properties. Determinant of a square matrix, Minors and Cofactors, Laplace's method of expansion of a determinant, Product of determinants, Adjoint of a determinant, Jacobi's theorem on adjoint determinant. Singular and non-Singular matrices, Adjoint of a matrix, Inverse of a non-singular

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

matrix and its properties, Orthogonal matrix and its properties, Trace of a matrix, Rank of a matrix and its determination using elementary row and column operations, Solution of simultaneous linear equations by matrix inversion method, Consistency and inconsistency of a system of homogeneous and non homogeneous linear simultaneous equations, Eigen values and Eigen vectors of a square matrix (of order 2 or 3), Eigen values, Caley-Hamilton theorem and its applications, Diagonalisation of a square matrix with real and distinct eigen values (up to 3rd order).

Unit II:

Successive Differentiation: Higher order derivatives of a function of single variable, Leibnitz's theorem (statement only) and its application, problems of the type of recurrence relations in derivatives of different orders.

Unit III:

Mean Value Theorems & Expansion of Functions: Rolle's theorem (statement only) and its application, Mean Value theorems – Lagrange & Cauchy (statement only) and their application, Taylor's theorem with Lagrange's and Cauchy's form of remainders (statement only) and its application, Expansions of functions by Taylor's and Maclaurin's theorem, Maclaurin's infinite series expansion of the functions.

Unit IV:

Integrals: Double and triple integrals and evaluation of area and volume. Change of order of integration.

Reduction formula: Reduction formulae both for indefinite and definite integrals.

D.Teaching/ Learning/ Practice Pattern:
Teaching: 70%
Learning: 30%
Practice: 0%

E. Examination Pattern:
Theoretical Examination: Written

F. Reading Lists:
Books:
1. Erwin Kreyszig, *"Advanced Engineering Mathematics",* Wiley Eastern.
2. Babu Ram, *"Engineering Mathematics",* Pearson Education.
3. H. K. Dass *"Higher Engineering Mathematics",* S. Chand & Co.
4. B.S. Grewal *, "Engineering Mathematics",* S. Chand & Co.
5. Pulak Kundu , *"A Text book on Engineering Mathematics"* Vol. I, Chhaya Prakashani.
6. Pal &Das, *"Engineering Mathematics"* Vol. I, U.N. Dhar.
7. John Bird *, "Higher Engineering Mathematics",*4th Edition, 1st Indian Reprint 2006, Elsevier.
8. L. Rade and B. Westergren, *"Mathematics Handbook: for Science and Engineering",* (5th edition, Indian Edition 2009, Springer).
9. M. J. Strauss, G. L. Bradley and K. L. Smith *, "Calculus",* 3rd Edition, 1st Indian Edition 2007, Pearson Education.
10. S. K. Adhikari, *"A text Book of Engineering Mathematics-I",* Dhanpat Rai and Co. (P) Ltd.
11. S. S. Sastry*, "Engineering Mathematics",* PHI, 4th Edition, 2008.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

12. Ravish R Singh, *"Engineering Mathematics",* McGraw Hill.
13. Das & Mukherjee, *"Differential Calculus",* U.N. Dhar& Sons Private Ltd.
14. Das & Mukherjee, *"Integral Calculus",* U.N. Dhar& Sons Private Ltd.

Magazines:
1. *Current Science* (Indian Academy of Science).
2. *The Mathematics Student* (Math Student) (Indian Mathematical Society).
3. *Mathematical Spectrum* (The University of Sheffield).
4. *Mathematics Magazine* (Mathematical Association of America).
5. *+Plus magazine* (University of Cambridge).
6. *Mathematics Today,* London Metropolitan University.

Journals:
1. *Journal of Engineering Mathematics,* Springer.
2. *Journal of Computational and Applied Mathematics,* London Metropolitan University.
3. *The Journal of Indian academy of Sciences.*
4. *Bulletin of Pure and Applied Sciences.*

Name of the Module: Engineering Chemistry
Module Code: CHY - 101
Semester: 1ˢᵗ
Credit Value: 4 [P=2, T=0, L=3]

A. Objectives:
The course is designed to meet with the objectives of:
1. Imparting theoretical and practical knowledge to the students in the area of Chemistry.
2. Providing teaching and learning to make students acquainting with advanced science and technology in Chemistry.
3. Injecting the future scope and the research direction in the discipline of Chemistry.
4. Making students competent to the research and development in advanced science and technology in Chemistry.

B. Learning Outcomes:
Students successfully completing this module will be able to:
1. Students will be adequately trained to become Chemists, Scientist and Chemical Engineers.
2. Students will be skilled both theoretically and practically to do operation, control and maintenance works in Chemistry and Chemical Engineering.
3. Students will be substantially prepared to take up prospective research assignments.

C. Subject Matter:
Unit I:

Chemical Thermodynamics: Concept of Thermodynamic System: diathermal wall, adiabatic wall, isolated system, closed system, open system, extensive property, intensive property Introduction to first law of thermodynamics: different statements, mathematical form; internal energy: physical significance, mathematical expression (ideal and real gas), Enthalpy: physical significance, mathematical expression. Cp and CV definition and relation; adiabatic changes; reversible and irreversible processes; application of first law of thermodynamics to chemical processes: exothermic, endothermic processes, law of Lavoisier and Laplace, Hess's law of

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

constant heat summation, Kirchoff's law. Second law thermodynamics; Joule Thomson and throttling processes; inversion temperature; evaluation of entropy: characteristics and expression, entropy change in irreversible process, entropy change for irreversible isothermal expression of an ideal gas, entropy change of a mixture of gases.

Work function and free energy: physical significance, mathematical expression for ideal and real gases obeying Vander Waals' equation, Gibbs Helmholtz equation.

Condition of spontaneity and equilibrium

UNIT II:

Electrochemistry Conductance: Conductance of electrolytic solutions, specific conductance, equivalent conductance, molar conductance and ion conductance, effect of temperature and concentration. Kohlrausch's law of independent migration of ions, transport numbers and hydration of ions. Conductometric titrations: SA vs SB & SA vs WB; precipitation titration KCl vs AgNO3.

Electrochemical cell: Cell EMF and its Thermodynamic significance, single electrode potentials and its applications; hydrogen half cell, quinhydrone half cell and calomel half cell. Storage cell, fuel cell. Application of EMF measurement. Reaction Dynamics: Reaction laws: rate and order; molecularity; zero, first and second order kinetics. Arrhenius equation. Mechanism and theories of reaction rates (Transition state theory, Collision theory).Catalysis: Homogeneous catalysis and heterogeneous catalysis.

UNIT III:

Structure and reactivity of Organic molecule: Electronegativity, electron affinity, hybridization, Inductive effect,resonance, hyperconjugation, electromeric effect, carbocation, carbanion and free radicals. Brief study of substitution, eliminations and addition reactions.

Instrumental Methods of Analysis: Introduction to instrumental methods such as IR, UV, VIS, NMR and Mass spectrometry.

UNIT IV:

Polymerization: Concepts, classifications and industrial applications. Polymerization processes (addition and condensation polymerization), degree of polymerization, Copolymerization, stereo-regularity of polymer, crystallinity and amorphicity of polymer. Preparation, structure and use of some common polymers: plastic (PE, PP, PVC, bakelite), rubber (natural rubber, SBR, NBR), fibre(nylon 6.6, polyester). Conducting and semi-conducting polymers.

Industrial Chemistry: Solid, liquid and gases fuels; constituents of coal, carbonization of coal. Coal analysis: Proximate and ultimate analysis. Classification of coal, petroleum (LPG, CNG), gasoline, octane number, aviation fuel, diesel, cetane number. Natural gas, water gas, Coal gas, bio gas. Bio-diesel.

D. List of Practicals: (Minimum eight experiments should be conducted by students)
1. Acid –base titration: (Estimation of commercial caustic soda)
2. Red-ox titration: (Estimation of iron using permanganometry)
3. Complex ometric titration: (Estimation of hardness of water using EDTA titration)
4. Chemical Kinetics: (Determination of relative rates of reaction of iodide with hydrogen peroxide at room temperature (clock reaction).
5. Heterogeneous equilibrium (Determination of partition coefficient of acetic acid between n-butanol and water)

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

6. Viscosity of solutions (determination of percentage composition of sugar solution from viscosity)
7. Conductometric titration for
   (a) Determination of the strength of a given HCl solution by titration against a standard NaOH solution.
   (b) Analysis of a mixture of strong and weak acid by strong base.
8. Preparation of a homo-polymer by free radical initiated chain polymerization and determination of its molecular weight by viscosity average molecular weight method.
9. pH- metric titration for determination of strength of a given HCl solution against a standard NaOH.

E. Teaching/ Learning/ Practice Pattern:
　　　　Teaching: 40%
　　　　Learning: 10%
　　　　Practice: 50%

F. Examination Pattern:
1. Theoretical Examination: Written.
2. Practical Examination: Conduct Practical Examination and viva-voce.

G. Reading Lists:
Books:
1. Rakshit P. C., *"Physical Chemistry"* Sarat Book Distributor.
2. Dutta R. L. *,"Inorganic Chemistry"* The New Book Stall.
3. Levine *" Physical Chemistry"* McGraw-Hill Education.
4. Finar I. L., *"Organic Chemistry (Vol. 1 & 2)."* Pearson.
5. lasston Samuel*, " Text Book of Physical Chemistry"* New York, D. Van Nostrand company.
6. Lee J. D.*, "Concise Inorganic Chemistry"* Wiley India.
7. Sykes,P.*, "Guidebook to Mechanism in Org.Chems",* Orient Longman.
8. Chakraborty D.K. *, "Solid State Chemistry",* New Age International.
9. Gupta M.C. *, "Atomic & Molecular Spectroscopy",* New Age.
10. Gowarikar V.R. *, "Polymer Science",* New Age.
11. Mishra G.S. *, "Introductory Polymer Chemistry",* New Age.
12. Nasipuri D. *,"Stereochemistry of Organic Compounds",* New Age.
13. Kalsi P.S*, "Spectroscopy of Organic Compounds",* New Age.
14. Kalsi P.S. *,"Organic Reactions & their Mechanism",* New Age.
15. Maity and Maity *," Engingeering Chemistry",*U & N Dhar Publisher.
16. *Ray, Das, Biswas, "Engingeering Chemistry", New Central Book Agency.*

Magazines:
1. *Chemical Science*
2. *Chemistry Today*
3. *Chemistry for You*

Journals:
1. *Journal of Organic Chemistry, ACS*
2. *Journal of Physical Chemistry, ACS*
3. *Material Science & Engineering B, Elsevier*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Name of the Module: Engineering Physics - I
Module Code: PHY - 101
Semester: 1ˢᵗ
Credit Value: 4 [P=2, T=0, L=3]

A. Objectives:
The course is designed to meet with the objectives of:
1. Imparting theoretical & practical knowledge to the students in the area of Engineering Physics.
2. Providing teaching and learning to make students acquainting with modern state-of-art of Engineering.
3. Injecting the future scope and the research direction in the field of Physics with specific specialization.
4. Making students competent to design & development of Engineering Physics.

B. Learning Outcomes:
Students successfully completing this module will be able to:
1. Students will be adequately trained to become Engineers.
2. Students will be substantially prepared to take up prospective research assignments.

C. Subject Matter:
Unit I:

Scalar and vector: Scalar and vector, dot and cross product, Scalar and vector fields, concept of Gradient, Divergence and Curl.

General Properties of Matter: Elasticity, Viscosity, Surface tension.
Unit II:

Acoustics: Simple Harmonic Motion, Damped Vibration, Forced Vibration

Thermal Physics: Kinetic Theory of Gas, conductivity & Radiation

Unit III:

Physical Optics: Introduction to Interference, Diffraction, Polarization

Elementary Solid State Physics: Elementary ideas of crystal structure : lattice, basis, UNIT cell, fundamental types of lattices-Bravis lattice, simple cubic, f.c.c and b.c.c lattices, Miller indices and miller planes, Co-ordination number and atomic packing factor, X-rays: Origin of characteristics and continuous X-ray, Bragg's law (no derivation), determination of lattice constant
Unit IV:

Fundamental of Quantum Physics: Wave particle duality, Compton effect, Photo electric effect, Heisenberg's uncertainty relation, concept of wave packet.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

D. List of Practicals: (Minimum five experiments should be conducted by students)
1. Determination of thermal conductivity of a good conductor by Searle's method
2. Determination of thermal conductivity of a bad conductor by Lees and Chorlton's method
3. Determination the dispersive power of the material of a given prism
4. Use of carry Foster's bridge to determine unknown resistance
5. Determination of Young Modulus by flexure method and calculation of bending moment and shear force at a point on the beam
6. Determination of coefficient of Viscosity by Poiseulle's capillary flow method
7. Determination of wavelength of light by Newton's ring method

E. Teaching/ Learning/ Practice pattern:
> Teaching: 40%
> Learning: 10%
> Practice: 50%

F. Examination Pattern:
1. Theoretical Examination: Written.
2. Practical Examination: Conduct Practical Examination and viva-voce.

G. Reading Lists:
Books:
1. Murrat R. Spiegel, Seymour Lipschutz & Dennis Spellman, *" Vector Analysis"* Second Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2009.
2. Takwale and Puranic, *"Classical Mechanics"* Tata McGraw-Hill Publishing
3. Sengupta & Chatterjeee, *"A Treatise on General Properties of Matter "* New Central Book Agency (P) Limited
4. D. Chattopadhyay and P. C. Rakshit, *" Vibrations, Waves and Acoustics"* Books and Allied (P) Ltd.
5. N. K. Bajaj, *"The Physics of Waves and Oscillations"* Tata McGraw Hill Education Private Limited, New Delhi.
6. A. Ghatak, *"Optics"* 4th Edition, Tata McGraw Hill Education Private Limited, New Delhi. .
7. S. O. Pillai, "*Solid State Physics*", Wiley Eastern Ltd.
8. Kittel, *"Solid State Physics"* 7th edition, Wiley India.
9. Richard P. Feynman, Robert B. Leighton and Matthew Sands, *" The FEYNMAN Lectures on Physics"* Vol. I to Vol. IV, Pearson
10. D. Chattopadhyay and P. C. Rakshit, *"An Advanced Course in Practical Physics"* New Central Book Agency (P) Ltd.

Magazines:
1. *Physics Reports*
2. *Quarterly Reviews of Biophysics*
3. *Resonance*
4. *American Teacher*
5. *Scientific Physics*
6. *Physics Today*
7. *Physics For You*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
Syllabus for B-Tech (chemical engineering)

Journals:
1. *Nature*
2. *Physical Review Letter*
3. *Physical Review A & B*
4. *Applied Physics Letters (APL)*
5. *Proceedings of the National Academy of Sciences*
6. *Chemical Physics Letters*
7. *Journal of Physics: (Including A, B, C, D, E, F & G) 8. Journal of Scientific & Industrial Research*
8. *Indian Journal of Engineering & Material Sciences*
9. *Indian Journal of Radio and Space Physics*

Name of the Module: Life Science
Module Code: BIO - 101
Semester: 1ˢᵗ
Credit Value: 3 [P=0, T=0, L=3]

A. Objectives:
The course is design to meet with the objectives of:
1. Imparting knowledge on the origin of Earth and life forms on Earth, appreciating importance of biological diversity and understanding biomolecules being the main component of life.
2. Understanding "Cell" – the basic UNIT in different life forms, and structure and function of different tissue systems in plants and animals.
3. Imparting knowledge on water relations, nutrient uptake and assimilation, and metabolism in plants.
4. Providing knowledge on Bioenergetics of plant and animal cells, different organelles involved in electron transport systems, nervous, digestive and immune systems in animals.

B. Learning Outcomes:
Upon completion of the subjects:
1. Students will understand the characteristics of living organisms; appreciate the importance of diversity of life and their interaction with the environment.
2. Students will be able to explain the interrelationship between biomolecules and the living system, and influences of biomolecules upon the structure and function of intracellular components.
3. Students will have a broad knowledge on Bioenergetics of plant and animal cells; and a brief on important biological systems of animal.

C. Subject Matter:
Unit I:
   Origin of Life: History of earth, theories of origin of life and nature of the earliest organisms.
   Varieties of life: Classification, Five kingdoms, viruses (TMV, HIV, Bacteriophage), Prokaryote (Bacteria-cell structure, nutrition, reproduction), Protista, Fungi, Plantae and Animalia.
   Chemicals of life: (Biomolecules)- Carbohydrates lipids, amino acids, proteins, nucleic acids and identification of biomolecules in tissues.
Unit II:
   Cell: Cell concept, structure of prokaryotic and eukaryotic cells, plant cells and animal cells, cell

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

membranes, cell organelles and their function, Structure and use of compound microscope.
Histology: Maritimes (apical, intercalary, lateral) and their function; simple tissue (parenchyma, collenchymas, sclerenchyma); Complex tissue (xylem and phloem); Tissue systems (epidermal, ground, vascular); primary body and growth (root, stem, leaf); Secondary growth (root, stem). Animal tissues (Epithelial, connective, muscle and nervous tissues) and their functions in the body.

Unit III:

Transport: Plant water relationships, properties of water, diffusion, osmosis, imbibition, uptake of water by roots and theories of transport of water through xylem (ascent of water in xylem, cohesion- tension theory), apoplast and symplast theory; Transpiration-structure of leaf, opening and closing mechanisms of stomata, factors affecting transpiration and significance of transpiration.

Nutrition: Mineral Nutrition in plants, Heterotrophic nutrition in plants; Photosynthesis (Autotrophic- forms of nutrition), Chloroplast structure, two pigment systems, photosynthetic UNIT, light absorption by chlorophyll and transfer of energy, phosphorylation and electron transport system, Calvin-Benson Cycle (C_3), Hatch Slack Pathway (C_4), Crassulacan Acid Metabolism (CAM), factors affecting photosynthesis.

Unit IV:

Energy Utilization: (Respiration) - Structure of mitochondria, cellular respiration, relationship of carbohydrate metabolism to other compounds, glycolysis, fermentation, formation of acetyl co-A, Kreb cycle, Electron Transport System and Oxidative Phosphorylation, ATP, factors affecting respiration;
Elementary canal in humans, nervous and hormonal control of digestive systems, fate of absorbed food materials; Nutrition in humans, Reference values; General characteristics of blood vascular system, development of blood systems in animals, Composition of blood, circulation in blood vessels, formation of tissue fluids, the heart, functions of mammalian blood, the immune system.

D. Teaching/ Learning/ Practice Pattern:
Teaching: 70%
Learning: 30%
Practice: 0%

E. Examination Pattern:
Theoretical Examination: Written

F. Reading List:
Books
1. J.N. Mitra, D. Mitra and S.K. Chowdhuri, *"Studies in Botany"* Volume I & II, Moulik Library Publisher, Kolkata,
2. M.J. Pelczar, E.C.S. Chan and N.R. Krieg, *"Microbiology",* Tata McGraw Hill Education, New Delhi, 1993.
3. B.P. Pandey, *"Plant Anatomy",* S. Chand & Company Ltd., New Delhi, 1997.
4. H.S. Srivastava, *"Plant Physiology",* Rastogi Publishers, Meerut, 1998.
5. B.P. Pandey, *"College Botany"* Volume I & II, S. Chand Publisher, New Delhi, 2012.
6. N.A. Campbell, J.B. Reece, *"Biology"* Person Education, Inc& Dorling Kinderley Publishing, Inc.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Magazines:
1. *National Geographic Chennel,* http://science.nationalgeographic.co.in/science/earth
2. *Wikipedia, The Free Encyclopedia,* http://www.bbc.co.uk/science/earth
3. *Wikipedia, The Free Encyclopedia,* http://en.wikipedia.org/wiki/HIV

Journals:
1. *Journal of Biology,* BioMed Central Ltd, London, England.
2. *Annals of Botany,* Oxford Journals, USA.
3. *Plant and Cell Physiology,* Oxford Journals, USA.

Name of the Module: Engineering Drawing - I
Module Code: CE - 101
Semester: 1ˢᵗ
Credit Value: 2 [P=3, T=0, L=0]

A. Objectives:
The course is design to meet with the objectives of:
1. Increase ability to understand Engineering Drawing.
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.

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

C. Subject Matter:
Unit I:
> **Indian Standards:** Line symbols and line groups; Sheet Layout of Rules of printing; Preferred scales.

Unit II:
> Theory of Orthographic Projection.

Unit III:
> Technical sketching; Multi-planar representation: First and third angle system of projection.

Unit IV:
> Glass box concept: Sketching of orthographic views and line.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

D. List of Practicals:
1. Technical writing of various types of letters.
2. Technical sketching of Scales- Plain, Diagonal, Vanier, Comparative and chord.
3. Technical sketching of Projection of points.
4. Technical sketching of Projection of lines.
5. Technical sketching of Projection of plains.
6. Technical sketching of Projection of solids.
7. Technical sketching of orthographic Projection

D. Teaching/ Learning/ Practice Pattern:
Teaching: 70%
Learning: 30%
Practice: 0%

E. Examination Pattern:
1. Practical Drawing.
2. Assignment.

F. Reading Lists:
  Books:
1. N. D. Bhatt, *"Machine Drawing"*. Charotar Publishing House Pvt. Ltd.
2. V. Laxmi narayanan & M. L. Mathur, *"A Text Book of Machine Drawing"*, Jain Brothers, New Delhi
3. Jolhe *"Machine Drawing"*, Charotar Publishing House Pvt. Ltd.
4. Venugopal K and Prabhu Raja V *"Engineering Graphics"*, New Age International Pvt. Ltd.
5. John, K C *"Engineering Graphics"*, PHI Learning Pvt. Ltd.
6. Kulkarni, D. M., Rastogi, A. P., Sarkar, A. K. *"Engineering Graphics with Autocad"*, PHI Learning Pvt. Ltd.
7. Natarajan, K. V *"Engineering Graphics"*, Dhanalakshmi Publisher
8. French and Vierk *"Fundamentals of Engineering Drawing"*, McGraw Hill
9. *Venugopal K and Prabhu Raja V ,"Engineering Graphics", New Age International Pvt. Ltd.*

Magazines:
1. *Machine Design.*
2. *Design to Part Magazine.*

Journals:
1. *International Journal of Design Engineering*

Name of the Module: Engineering Mechanics
Module Code: ME - 101
Semester: 1ˢᵗ
Credit Value: 3 [P=0, L=3, T=0]

A. Objectives:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

The course is design to meet with the objectives of:

1. Ability to utilise scalar and vector analytical techniques for analysing forces in statically determinate structures.
2. Ability to apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
3. Student gets a basic idea of Centre of gravity, moment of inertia, mass moment of inertia, Friction.

B. Learning Outcome:
Upon completion of the subject:
1. Should have knowledge of different type of force resolving
2. Should have knowledge of centre of gravity of different size, shape, and solid.
3. Should have knowledge of basic idea of Centre of gravity, moment of inertia, mass moment of inertia, friction.

C. Subject Matter:
UNIT I
Forces and Moments: Force, Moment and Couple, Resultant of forces, Forces in space. Equilibrium, FBD, General equations of equilibrium, Analysis of forces in perfect frames. Brief introduction to vector approach.
UNIT II
Friction: Introduction to dry friction. laws of friction, friction of simple machines- inclined planes, Screw jacks.
UNIT III
Center of gravity and moment of inertia: Center of gravity of axes, volume and composite bodies: Area moment of inertia and mass moment of inertia for plane figures and bodies
UNIT IV
Kinetics of rigid bodies: Plane motion, force, mass, acceleration. Work and energy, Impulse and momentum, rotational motion, centrifugal force, torque, angular motion and acceleration, angular momentum, D Alembert's principle, Virtual work.

D. List of Practicals: No Practicals

E. Teaching/ Learning/ Practice pattern:
Teaching: 60%
Learning: 40%
Practice: 0%

F. Examination Pattern:
1. Theoretical Examination.

G. Reading lists:
Books:
1. Mariam & Kraige*, "Engineering Mechanics"* (Vol-II) Dynamics, Wiley Publisher
2. *Meriam & Kraige, "Engineering Mechanics"* Vol-I (Statics), Wiley Publisher
3. Timoshenko *, "Engineering Mechanics",* McGraw Hill Publisher

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

4. Nelson, *"Engineering Mechanics"*, Tata McGraw Hill Publication
5. Shames and Rao*, "Engineering Mechanics",* Pearson Publisher
6. Suman Chakraborty*, "Engineering Mechanics",* Everest Publishing House
7. Beer and Johnson, *"Vector Mechanics for Engineers",* Tata McGraw Hill Publication

Magazines:
1. Popular Mechanics Everyday
2. Engineering Magazine

Journals:
1. International Journal of Applied Mechanics and Engineering
2. Journal of Applied Mechanics, ASME
3. Journal of Engineering Mechanics, ASCE.

Name of the Module: Workshop Practice - I
Module Code: ME - 102
Semester: 1ˢᵗ
Credit Value: 2 [P=3, T=0, L=0]

A. Objectives:
The course is design to meet with the objectives of:
1. To acquire skills in basic engineering practice.
2. To identify the hand tools and instruments.
3. To acquire measuring skills.
4. To acquire practical skills in the trades.
5. To acquire practical skills in welding, carpentry, Fitting.

B. Learning Outcome:
Upon completion of the subject:
1. Should have knowledge of workshop safety.
2. Should have knowledge of Handling workshop tools, machines.
3. Should have knowledge of different welding types.
4. Should have knowledge of different carpentry joints
5. Should have knowledge of different tools working principle

C. Subject Matter:

Unit I:
Carpentry (Wood Working): Timber, Seasoning and Preservation, Plywood and Plyboards, Carpentry Tools, Engineering applications. Different Joints

Unit II:
Metal Joining: Definitions of welding, brazing and soldering processes, and their applications. Oxy acetylene gas welding process, equipment and techniques. Types of flames and their applications. Manual metal arc welding technique and equipment. AC and DC welding, electrodes, constituents and functions of electrodes. Welding positions. Types of weld joint. Common welding defects such as cracks, slag inclusion and porosity.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Unit III:

Bench work and Fitting

Tools for laying out, chisels, files, hammers, hand hacksaw, their specifications and uses.

Unit IV:

Laying out (bench work): Sawing and Finishing by Filing.

D. List of Practicals:
1. T-Lap joints and Bridle joint (Carpentry Shop).
2. Gas Welding practice on mild steel flat/sheet upto 3 mm thick.
3. Lap joint by Gas Welding (upto 3mm thick).
4. Manual Metal Arc Welding practice (upto 5mm thick).
5. Pattern Making. (Carpentry Shop)
6. Laying out (bench work); Sawing and Finishing by Filing.

E. Teaching/Learning/Practice Pattern:

Teaching: 20%

Learning: 20 %

Practice: 60%

F. Examination Pattern:
1. Job making.
2. Viva-voce.

G. Reading Lists:

Books:
1. M.L. Begeman and B.H. Amstead, *"Manufacturing Process"* John Wiley, 1968.
2. W.A.J. Chapman and E.Arnold, *"Workshop Technology"* Vol. 1, 2 & 3, CRC press Prentice Hall
3. B.S. Rghuwanshi, *"Workshop Technology"* Vol. 1 & 2 – Dhanpat Rai and Sons.
4. Hazra and Choudhary *"Workshop Technology"* Vol. 1, 2, Media Promoters
5. Virender Narula *"Workshop Technology",* S. K. Kataria & Sons

Magazines:
1. *International Metal Working News.*
2. *Industrial Distribution*

Journals:
1. *International Journal of Machine Tools and Manufacture*
2. *Journal of Manufacturing Science and Engineering, Transactions of the ASME*
3. *Journal of Manufacturing Technology and Research*

Name of the Module: Basic Electrical & Electronics Engineering
Module Code: EE - 101
Semester: 1st

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Credit Value: 4 [P=2, T=0, L=3]

A. Objectives:

The course is designed to meet with the objectives of:
1. To make the students familiar with the course and its importance.
2. Introduction to Basic Electrical & Electronics Engineering.
3. Basic knowledge of DC circuits, Electromagnetism, AC fundamental.
4. Introduction to DC, AC single and three phase machine, their construction and working principles.
5. Introduction to measurement of electrical quantities.
6. Making familiar with P-N Junction.
7. Briefing to Semiconductor devices and their applications

B. Learning Outcomes:

Students successfully completing this module will be able to:
1. Students will develop interest in learning the subject and be adequately trained to solve network problems.
2. Students will be skilled both theoretically and practically to utilize conventional circuit solving procedures.
3. Students will be substantially prepared to take up prospective design assignments.

C. Subject Matter:

Unit I:

DC circuits: Definition of electric circuit, network, linear circuit, non-linear circuit, bilateral circuit, unilateral circuit, Dependent source, Kirchhoff's law, Principle of superposition. Source equivalence and conversion, Thevenin's theorem, Norton Theorem, nodal analysis, mesh analysis, star-delta conversion. Maximum power transfer theorem with proof.

Electromagnetism: Biot-Savart law, Ampere's circuital law, field calculation using Biot-savart &ampere's circuital law. Magnetic circuits, Analogous quantities in magnetic and electric circuits, Faraday's law, selfand mutual inductance. Energy stored in a magnetic field, B-H curve, Hysteretic and Eddy current losses, lifting power of Electromagnet.

Unit II:

Decision making: Simple If statement, if-else statement, nested if else statement, Switch statement, nested switch, the operator, goto statement.
Decision making & branching: while statement, do-while statement, for statement. Array

Unit III:

Transformers: Construction,Types, emf equation, voltage, current, impedence and turns ratio; auto-transformer. DC machines (motor and generator)–Construction, types, emf equation, equivalent circuit, starting, speed control, braking, applications. Single phase motors, types; need of rotating field, starting, running, speed control and applications.

Unit IV:

P-N Junction: Energy band diagram, Formation of P-N junction, built-in-potential forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener breakdown, Avalanche breakdown and its reverse characteristics, junction capacitance and varactor diode. Simple diode circuits, load line, linear piecewise model; rectifiers: half

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

wave, full wave, its PIV, DC voltage and current, ripple factor, efficiency, Clipper & Clamper Circuits.

Introduction to Transistors: Formation of PNP/ NPN junctions, energy band diagram; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off active and saturation mode, early effect. Introduction to Field Effect Transistor: Structure and characteristics of JFET and MOSFET, depletion and enhancement type, CS, CG, CD configurations.

D. List of Practicals: (Minimum eight experiments should be conducted by students)
1. To construct a series-parallel circuits and verify:
    Ohms law, Kirchhoff's laws
    Verify Thevenin's theorem.
    Verify Norton's theorem.
    Verify Maximum Power Transfer theorem.
2. Constructan R-L-C circuit and verify
    Voltage across R, L and C
    Verify the phasor sum of the voltages across the combination of R-L-C.
3. Measurement of power in the circuit made in 2 above and verify:
    The power consumed by Resistance, Inductance and Capacitance and the total power consumed by the circuit.
4. How does the power factor varies in the circuit of 2 above if Resistance, Inductance and Capacitance are varied.
5. Study of VI Characteristics of Silicon Diode.
6. Study of VI Characteristics of Zener Diode.
7. Design and Analysis of a Half wave Rectifier using Diode.
8. Design and Analysis of a center-tap Full wave Rectifier using Diodes
9. Design and Analysis of a Bridge Rectifier Circuit.
10. Design and Analysis of a Clipping Circuit with one voltage source. (Different possible configurations)
11. Design and Analysis of a Clipping Circuit with two voltage source. (Different possible configurations)
12. Design and Analysis of a Clamper Circuit.
13. Analysis of the characteristics of BJT (CE and CB mode)
14. Design and Analysis of fixed bias circuit using NPN transistor (DC)
15. Design and Analysis of emitter bias circuit using NPN transistor (DC)
16. Determination of the characteristics of JFET.
17. Determination of the characteristics of MOSFET.
18. Verification of truth tables of logic gates.

E. Teaching/ Learning/ Practice Pattern:
    Teaching: 40%
    Learning: 10%
    Practice: 50%

F. Examination Pattern:
1. Theoretical Examination: Written.
2. Practical Examination: Conduct Practical Examination and viva-voce.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
Syllabus for B-Tech (chemical engineering)

G. Reading Lists:

Books:
1. Theraja, *"Electrical technology, Vol 1 &2",* Nirja Construction & Development Co. (P) Ltd.
2. Sen, P.C. *"Principles of Electrical Machines and Power Electronics"* John Wiley and Sons.
3. V.K.Mehta, *"Basic Electrical Engineering"* S.Chand and Co. Publication.
4. Guru and Hiziroglu *"Electric Machinery and Transformers",* Saunders College Pub. NY, 1990
5. Malvino,*"Electronic Principle"* Tata McGraw-Hill Publishing Co.Ltd.
6. Millman & Halkias*, "Integrated Electronics"* Tata McGraw-Hill Publishing Co.Ltd.
7. Boylestead and Nashelsky, *Electronic Devices and Circuits Theory,* 9/e, PHI, 2006.
8. R.P.Jain, " *Modern Digital Electronics",*3/e,TMH,2000.

Magazines:
1. *IEEE Industrial Electronics*
2. *2. Electrical Line, Canada.*

Journals:
1. *Electrical Engineering, Springer.*

Name of the Module: Communication Skill
Module Code: HSS - 101
Semester: 1ˢᵗ
Credit Value: 1 [P=2, T=0, L=0]

A. Objectives:
The course is design to meet with the objectives of:
1. To increase the Students ability to improve and utilize the skills necessary to be competent interpersonal communicator.
2. To Increase the student's understands of his or her own communication behavior.
3. To Increase the students understands of others communication behaviours.
4. To improve the students communication skills of both social professional contexts.
5. To improve the students ability to demonstrate effective complete resolution skills.

B. Learning Outcomes:
Students successfully completing this module will be able to :
1. The students will be able to develop their communication skills on the specific subject.
2. After learning communication skills they will be able to direct effectively in their world place.

C. Subject Matter:
Unit I:

General Principles of Communication and Oral Communication: The Process of Communication, Principles of Communication (communication barriers, levels of Communication, Communication network, verbal, non-verbal) and Professional Communication. The Speech Mechanism, IPA symbols (vowel and consonant sounds), minimal pairs, word

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

transcription, stress and intonation , active listening, types of listening, traits of a good listener, active versus passive listening,

Unit II:

Constituents of Effective Writing and Vocabulary: The sentence and its parts, articles, the verb phrase, tense and aspect, the active and passive, the adjective, interrogative and negative sentences, concord, preposition. Paragraph development, summary writing and reading comprehension. Word formation processes: affixation, compounding, converting, use of words in different parts of speech, idioms and phrases.

Unit III:

Business Correspondence and Communication Strategies: Characteristics of Business Letters, Drafting: Bio-data/Resume/Curriculum vitae (theory). Report Writing: Structure, Types of Reports (theory). Presentation Skills, public speaking and group discussion (theory) and Soft Skills (theory).

D. List of Practicals:
1. Issue Writing
2. Writing Resumes and Applications
3. Writing Memos
4. Reading Comprehension
5. Vocabulary
6. Presentation Skills
7. Group Discussion
8. Extempore
9. Debates

E. Teaching/ Learning/ Practice Pattern:
Teaching: 40%
Learning: 10%
Practice: 50%

F. Examination Pattern:
1. Theoretical Examination

G. Reading Lists:

Books:
1. Nira Konar, *"English Language Laboratory",* Prentice Hall India
2. Jones, Daniel, *"Cambridge English Pronouncing Dictionary with CD",* New Delhi, 2009.
3. Roach, Peter*, "English Phonetics and Phonology with CD",* CUP, India, 1983.
4. *"Cambridge Learners Dictionary with CD", CUP, New Delhi, 2009.*
5. Rajeevan, Dutt, Sasikumar*, "A course in Listening and Speaking I & II with CD",* CUP, New Delhi, 2007.
6. Rajeevan and Dutt, *"Basic Communication Skills",* CUP, New Delhi, 2007.
7. Software, "*Orell Digital Language Lab Software".*
8. R.C. Sharma and Krishna Mohan *"Business Correspondence and Report Writing",* Meenakshi
9. Raman and Sangeeta Sharma, *"Technical Communication",* Oxford*.*
10. Krishna Mohan and Meera Banerjee *, "Development Communication Skills".*

Magazines:
1. *Communication Skill Magazine*
2. *Magazine for Communication*
3. *Communication Studies*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Journals:
1. *Developing Effective Communication Skills.*
2. *Cooperative Communication Skills.*
3. *Improving Communication Skills.*
4. *Key Communication Skills.*
5. *Journal on Communication.*

Name of the Module: Foreign Language (French) (Audit)
Module Code: HSS - 103
Semester: 1ˢᵗ
Credit Value: 0[P=2, T=0, L=0]

A. Objectives:
The course is design to meet with the objectives of:
1. The French Language course accords to a method created for Indian students who are complete beginners in French and who wish to acquire verbal communication skills in current scenario.

B. Learning Outcome:
Students successfully completing this module will be able to :
2. Develop four skills in French i.e. Reading, Writing, Speaking, Comprehension.

C. Subject Matter:
Unit-I:
Articles, Gender and Number of Nouns and Adjectives. Personal and Tonique Pronouns, Demonstrative and Possessive Adjectives, Preposition and Adverbs.
Unit-II
Pronominal Verbs Conjugation of Verbs of all the Groups in present Tense and Introduction to past and Future tense ,Interrogation, Negation and Imperatives.
Unit-III
Name of days, seasons. Months, colours, garments body parts and numbers. Computer, Commerce & Marketing related Vocabulary &Terminology, Phonetics and Pronunciation.

D. List of Practicals:
1. Issue Writing
2. Writing Resumes and Applications
3. Writing Memos
4. Reading Comprehension
5. Vocabulary
6. Presentation Skills
7. Group Discussion
8. Extempore
9. Debates
E. Teaching/ Learning/ Practice Pattern:
Teaching: 40%

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Learning: 10%
Practice: 50%
F. Examination Pattern:
   1. Theoretical Examination
G. Reading List:
   Books:
Suggested book-Ailes Volume-I

SEMESTER - II

Subject Code	Subject	Model	P	T	L	Credit
MAS - 201	Engineering Mathematics - II	SNB	0	1	3	4
ME - 201	Basic Elements of Mechanical Engineering	SNB	0	0	3	3
CSE - 201	Programming in C	JCB	8	0	0	4
CHY - 201	Environmental Science	JCB	0	0	3	3
PHY - 201	Engineering Physics - II	SNB	2	0	3	4
ECE - 201	Digital Electronics & Logic Design	JCB	2	0	3	4
HSS - 201	Historiography of Science & Technology	JCB	0	0	3	3
HSS - 202	Foreign Language (French) (Audit)	JCB	2	0	0	0
CE - 201	Basic Civil Engineering	JCB	0	0	3	3
ME - 202	Workshop Practice II	JCB	3	0	0	2
			17	1	21	30

Name of the Module: Engineering Mathematics-II
Module Code: MAS - 201
Semester: 2nd
Credit Value: 4 [P=0, T=1, L=3]

A. Objectives:
The course is design to meet with the objectives of:
   1. Imparting theoretical knowledge to the students about three and more dimensional objects in space and to improve their capability of visualising of objects in space.
   2. Making student competent enough to construct a differential equation/ mathematical modelling for every real life situation with its solution.
   3. Giving students theoretical knowledge of vectors with the flavour of Calculus.
   4. Introduce the concepts of Laplace and Fourier transforms and its application to the solution of differential equations (ODE & PDE) to the students.

B. Learning Outcomes:
Upon completion of the subject:
   1. Students will have strong visualising capability in their mind about any object.
   2. Students are so trained that they will recognize various real life situation/ problem and able to solve them by constructing a differential equation/ mathematical model.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

3. Students will be able to find the Laplace and Fourier representation as well as transforms of functions of one variable.

C. Subject Matter:
Unit I:
Coordinate Geometry Of Three Dimensions: Equation of a sphere, plane section of a sphere, tangent plane, orthogonality of spheres, definition and equation of right circular cone and right circular cylinder.

Unit II:
Vector Calculus: Differentiation and integration of vector functions, scalar and vector fields, Gradient, Directional derivative, Divergence, Curl. Line integral, Surface integral and Volume integral, Green's, Gauss' and Stokes' theorems (without proofs) and their simple applications.

Unit III:
Ordinary Differential Equations: Formulation of Differential equations, Linear Differential Equations and reducible tolinear form, Exact Equations, Reducible to exact form, Linear differential equations with constant coefficients, Second order ordinary differential equations with variable coefficients, Homogeneous form, Change of dependent variable, Change of independent variable, Normal form, Variation of Parameters, Solution in series of second order LDE with variable co-efficient (C.F. only), Bessel's and Legendre differential equations with their series solutions, Orthogonal properties, recurrence relations and generating function of Bessel functions and Legendre polynomials.

Partial Differential Equation: Linear and non-linear Partial Differential Equation of order one, Linear Partial Differential Equation with constant coefficient, Partial Differential Equation of order two with variable coefficients.

Unit IV:
Basic Transform: Laplace & Fourier.

D: Teaching/ Learning/ Practice Pattern:

Teaching: 70%
Learning: 30%
Practice: 0%

E: Examination Pattern:
Theoretical Examination and open book examination.

F: Reading Lists:
  Books:
   1. Shanti Narayan, *"Analytic Solid Geometry",* S. Chand.
   2. M. D. Raisinghania, *"Vector Analysis",* S. Chand.
   3. R. K. Jain& S R. K Iyengar, *"Advanced Engineering Mathematics",* Narosa.
   4. M. D. Raisinghania, *"Ordinary & Partial Differential equations",* S. Chand.
   5. M. D. Raisinghania, *"Advanced Differential equations",* S. Chand.
   6. H. K. Dass, *"Higher Engineering Mathematics",* S. Chand & Co.
   7. B. S. Grewal , *"Engineering Mathematics",* S. Chand & Co.
   8. Erwin Kreyszig, *"Advanced Engineering Mathematics",* Wiley Eastern.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

9. S. L. Ross, *"Differential equations",* Willey.
10. Pal & Das , *"Engineering Mathematics",* Vol. I, U. N. Dhar.
11. J. N. Sharma, A. R. Vasishtha, *"Vector Calculus",* Krinhna Prakashan Mandir, Meerut.
12. P. P. Gupta, G. S. Malik, *"Vector Calculus",* Kedarnath Ramnath, Meerut.
13. Brahma Nand, B. S. Tyagi, B. D. Sharma, *"Co-ordinate Solid Geometry",* Kedarnath Ramnath, Meerut, Delhi.
14. A. R. Vasishtha, D. C. Agarwal, *"Analytical Geometry of Three Dimensions",* Krinhna Prakashan Media (P) Ltd, Meerut.

Magazines:
1. *Current Science (Indian Academy of Science).*
2. *The Mathematics Student (Math Student) (Indian Mathematical Society).*
3. *Mathematical Spectrum (The University of Sheffield).*
4. *Mathematics Magazine (Mathematical Association of America).*
5. *+Plus magazine (University of Cambridge).*
6. *Ganithavahini (Ramanujan Mathematical Society).*
7. *Mathematics Today, London Metropolitan University.*

Journals:
1. *Journal of Engineering Mathematics, Springer.*
2. *Journal of Computational and Applied Mathematics, London Metropolitan University.*
3. *The Journal of Indian academy of Sciences.*
4. *Bulletin of Pure and Applied Sciences.*

Name of the Module: Basic Elements of Mechanical Engineering
Module Code: ME - 201
SEMESTER: 2ⁿᵈ
Credit Value: 3 [P=0, T=0, L=3]

A. Objectives:
The course is design to meet with the objectives of:
1. Ability to utilise scalar and vector analytical techniques for analysing forces in statically determinate structures.
2. Ability to apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
3. Student gets a basic idea of Engineering Mechanics, Fluid Mechanics, Strength of Material and Thermodynamics.

B. Learning Outcome:
Upon completion of the subject:
1. Should have knowledge of different type of force resolving
2. Should have knowledge of centre of gravity of different size, shape, and solid.
3. Should have knowledge of basic idea of Engineering Mechanics, Fluid Mechanics, Strength of Material and Thermodynamics.

C. Subject Matter:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Unit I:

Thermodynamics: Introduction to Thermodynamics, Concepts of system control volume, state, properties, equilibrium, quasi- static process, reversible & irreversible process, cycle. Zeroeth Law and Temperature, Heat and Work transfer Definition, Sign convention, various P-dV work done (Isobaric ,Isochoric, Polytrophic, adiabatic and isothermal processes) and related problems.

1st Laws of Thermodynamics for closed & open systems (ii) Non Flow Energy Equation (iii) Steady State, Steady Flow Energy Equation and related problems. , Equivalence of two statements, Definition of Heat Engines, Heat pumps, Refrigerators Carnot and related problems. Air Standard cycles – Otto and Diesel cycle and their efficiencies and related Problems

Unit II:

Fluid Mechanics: Properties & Classification of Fluids – ideal & real fluids, Newton's law of viscosity, Newtonian & Non Newtonian Fluids, Compressible & Incompressible fluids Pressure at a point, Pascal's law. Measurement of Pressure. Continuity equation. Bernoulli's equation and its application,

Unit III:

Statics: Particle and Rigid body concept; Types of forces (collinear, concurrent, parallel, concentrated, distributed). Vector and scalar quantities, Transmissibility of a force (sliding vector); Lame's Theorem. Two and three dimensional force systems; Moment and Couple, Varignon's theorem, Resultants, Free body concept.

Centroid and Centre of Gravity:

Moments of inertia of plane figures: M.I. of plane figures : MI of plane figure with respect to an axis in its plane; MI of plane figure with respect to an axis Parallel to the plane of the figure

Unit IV:

Strength Of Materials: Concept of simple stresses and strains. Yield strength, Normal stress Shear stress, Bearing stress, Normal strain, Shearing strain, Hooke's law, poisson's ratio, Examples.

Dynamics: Kinematics and Kinetics; Rectilinear motion of particles; determination of position velocity and acceleration – under uniform rectilinear motion (uniform and non-uniform accelerated rectilinear motion), Relative motion, construction of x-t, v-t and a-t graphs (simple problems), Projectile motion, Normal and Tangential components, Radial and Transverse components, simple problems. Equation of motion, D.Alembert's principle.

D. List of Practical: No Practicals**.**

E. Teaching/Learning/Practice Pattern:

Teachnig:60 %

Learning :40 %

Practice : 0%

F. Examination Pattern:

1. Theoretical Examination

G. Reading List:

Books

1. P.K. Nag *, "Engineering Thermodynamics"* 2nd Edition, Tata McGraw Hill Publisher

2. S.K. Som & G. Biswas, *"Introduction to Fluid Mechanics & Fluid Mechines"* Tata McGraw Hills

3 Timo & Young*, "Elements of Strength of Materials"* D Van Nostrand Company

4. Mariam & Kraige*, "Engineering Mechanics (Vol-II) Dynamics"* Wiley Publisher

5 Meriam & Kraige*, "Engineering Mechanics, Vol-I (Statics)"* Wiley India

Magazines:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

1. *Popular Mechanics. Everyday*
2. *EngineeringMagazine*

Journals:
1. *International Journal of Applied Mechanics and Engineering*
2. *Journal of Applied Mechanics, ASME*
3. *Journal of Engineering Mechanics, ASCE.*

Name of the Module: Programming in C
Module Code: CSE - 201
Semester: 2ⁿᵈ

Credit Value: 4 [P=8, T=0, L=0]

A. Objectives:
The course is designed to meet with the objectives of:

1. Introducing art, science and engineering of C programming language to the students of all UG programs,
2. Teaching and training of different problems in data structures,
3. Guiding and training students to write efficient coding,
4. Guiding & training students to fragment problems into different functions or units.

B. Learning outcomes:
Students successfully completing this module will be able to:
1. Understand the basic terminology used in computer programming
2. Write, compile and debug programs in C language in different operating systems.
3. Design programs involving decision structures, loops and functions.
4. Use and apply the dynamics of memory by the use of pointers in engineering applications.
5. Use and apply the differences between structure oriented and function oriented programming in programming applications.

C. Subject Matter:
   Unit I:
   Basic concept: Some basic concept of binary number, Octal number, hexadecimal number system and there conversion among them. Assembly language, high level language, Compiler and assembler (basic concept).
   Keyword & Identifiers: History & Importance of C, Basic structure of C programs, C fundamentals: The C character set identifier, Constants and keywords, data types & size, variable names, declaration, statement , C token, symbolic constent.
   Operators and Expression: Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Increment & Decrement operators, Condition Operators, Bitwise Operators, Special operators, precedence of arithmetic operators.
   Managing Input & output operations: using of printf( ) &scanf( ).
Unit II:
   Decision making: Simple If statement, if-else statement, nested if else statement, Switch statement, nested switch, the operator, goto statement.
   Decision making & branching: while statement, do-while statement, for statement. Array
Unit III:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

String & pointer: One-dimension array, Two-dimension array and multi dimension array. String: Operation on String without using library function and using library function. Pointer: Declaration of pointer variables, accessing the variable by using pointer, pointer increment and decrement operator, pointer and array.

Functions: Basic functions, function type, function with no argument & no return value, function with no argument but return value, function with argument & return value, Storage class identifier, Call by reference, Recursive function. Pointer to function.

Unit IV:

Structure & Union: Defining a structure, accessing of structure variable, structure and array, array within structure. Nested structure, structure & functions, Pointer & structure, Unions.

File management system: Advantage of using file, Open, close, read. write in the files, Operation on files.

Dynamic memory Allocation: use of Malloc, calloc, realloc, free. Library functions, Linked list concept.

The pre-processor: macro statements.

D. List of Practicals: (Minimum eight experiments should be conducted by students)

1. Write a program to find the highest number of a given set of numbers and print the numbers of the set in descending order. [Minimum size of set=50]
2. Write a program to list even numbers and odd numbers separately in ascending order of a given set of minimum size of 50.
3. Write a program to find roots of a given quadratic equation.
4. Write a program to test whether a given number is prime or not.
5. Write a program to check whether a given number is a palindrome or not (for eg. 121-→121).
6. Write a program to compute the following series and test it for different inputs.

   a) $2 + 4 + 6 + 8 \ldots \ldots \ldots \ldots \ldots \ldots \ldots$
   b) $f(x) = 1! + 2! + 3! + 4! + \ldots \ldots \ldots$
   c) $f(x) = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots \ldots \ldots$
   d) $f(x) = 1 + x + x^2 + x^3 + x^4 + \ldots \ldots \ldots$

7. Write a program to display the following patterns using nested for loops.

```
a)  *           b) ####      c) 1010     d)    *       e) ABCDCBA    f) |*       *
    * *             ###          010           * *        ABC  CBA      **     **
    * * *           ##           10          * * *        AB    BA      ***   ***
    * * * *         #            0          * * * *       A      A      ********
```

8. Write a C program to find the maximum element from given input array elements.
9. Write a C program to sort an array elements using BUBBLE sort.
10. Implement the C program for the following numbering system conversion:
    1. Decimal to Binary and Vice-versa (By a single algorithm both for integer and fractional part).
    2. Octal to Binary and Vice-versa.
    3. Hexadecimal to Binary and Vice-versa.
11. Write a program to add two given matrices each of size (nXm).
12. Write a program to multiply any two given matrices.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

13. Write a program to check whether a given matrix is Identity matrix or not.
14. Write a program to generate calendar of a given year & print both in desk and wall mode.
15. Write a program to implement factorial of a given input using recursive function.
16. Write a program to differentiate between call by value and call by reference.
17. Write a program to pass an array to a function and find minimum value of it.
18. Write a program to explain scope, visibility and the lifetime of variables.
19. Write a program to explain reference variable and its implementation.
20. Write a program to swap two values using pointer and function.
21. Write a mini project to store all records of students and search by their name, roll number or registration number.
22. Write a program the explain the concept of pointer to a structure..
23. Write a program to differentiate between Enumerated data types, Union and Structures.
24. Write a program to create, edit, open, delete a file and perform different operations accordingly.
25. Write a program to backup one file to another file.
26. Write a program to merge two files.
27. Write a mini project to control mouse cursor and display whether left, right or scroll happens.

E. Teaching/ Learning/ Practice Pattern:
> Teaching: 40%
> Learning: 10%
> Practice: 50%

F. Examination Pattern:
> 3. Theoretical Examination: Open book and on line.
> 4. Practical Examination: Conduct Programming test and viva voice.

G. Reading lists:
Books
1. Kerninghan and Ritchie , *"The 'C' programming language",* Prentice Hall.
2. Yashavant P. Kanetkar*, "Let Us C",* Infinity Science Press, 2008.
3. Herbert Schildt, *"C: The Complete Reference",* McGraw-Hill Education, 2000.
4. Balaguruswamy, *"Programming InAnsi C, 5E",* Tata McGraw-Hill Education, 2011.
5. Govil, Agrawal, Mathur& Pathak, *"Computer Fundamentals and Programming in C",* Jaipur Publication House (JPH)
6. M.T. Somashekara, *"Programming in C",* PHI Learning Pvt. Ltd., 2005.
7. Sinha & Sinha, *"Foundations of Computing",* BPB Publications, 2002.
8. J. B. Dixit, *"Computer Fundamentals and Programming in C",* Firewall Media, 2009.
9. Stephen G. Kochan, *"Programming in C",* Addison-Wesley Professional, 2014.
10. K. N. King, *"C Programming: A Modern Approach",* W.W. Norton, 2010.
11. Zed Shaw, *"Learn C the Hard Way",* Addison Wesley Professional, 2015.
12. Steve Oualline, *"Practical C Programming, 3rd Edition",* O'Reilly Media, Inc., 2003.
13. Ajay Mittal, *"Programming In C: A Practical Approach",* Pearson Education India, 2010.
14. A.P.Godse, D.A.Godse, *"Computer Concepts and Programming in C",* Technical Publications, 2008.

H. Magazines:
> 1. *C/C++ Users, CMP Media LLC publication, United States.*
> 2. *EPS Software Corp/CODE Magazine, 6605 Cypresswood Drive, Suite 300 Spring, TX 77379.*

Journals:
1. Science of Computer Programming*: Methods of Software Design: Techniques and Applications,*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Elsevier, ISSN:0167-6423
2. *Programming and Computer Software,* Springer, ISSN: 0361-7688.
3. *Dr. Dobb's Journal,* United Business Media publication, United State,ISSN: 1044-789X
4. *Journal of C Language,* CMP Media LLC publication, United States
5. *C vu Journal,* ACCU, UK.

Name of the Module: Environmental Science
Module Code: CHY - 201
Semester: 2nd
Credit Value: 3 [P=0, T=0, L=3]

A. Objectives:
The course is designed to meet with the objectives of:
1. Imparting the knowledge to the students in the area of Environmental Engineering.
2. Providing teaching and learning to make students acquainting with advanced science and technology in Environmental Science.
3. Injecting the future scope and the research direction in the discipline of Environmental Engineering.
4. Making students competent to the research and development in Environmental Engineering.

B. Learning Outcomes:
1. Students successfully completing this module will be able to:
2. Students will be adequately trained to become Scientist, trainers and Chemical Engineers.
3. Students will be skilled both to control and maintenance in Environmental pollution, waste water treatment and other related activities in Environmental Engineering.
4. Students will be substantially prepared to take up prospective research assignments.

C. Subject Matter:

Unit I:

Environment: Concepts of Environment, Environmental gradients, Tolerance levels of environment factor,
EU, US and Indian Environmental Law. Chemistry in Environmental Engineering: Chemistry of the
atmosphere, combustion related air pollution, global environmental problems - ozone depletion, greenhouse
effect, acid rain etc.

Ecological Concepts: Biotic and Abiotic components, Ecosystem Process: Energy transfer, Food Chain and Food Web, Water cycle, Oxygen cycle, Carbon cycle, Nitrogen cycle etc., Soil chemistry. Soil composition, properties, identification and classification. Noise pollution Effect of noise on people, rating systems, community noise sources and criteria, traffic noise pr ediction, noise cotrol. Noise standards, measurement and control.

Unit II:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Waste Water Treatment: Water Treatment: water quality standards and parameters, Ground water. Water treatment processes, Pre-treatment of water, Conventional process, advanced water treatment process. DO and BOD of Waste water treatment process, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion, Reactor configurations and methane production. Water resources, characteristics of water, water pollutants, oxygen demanding wastes, surface water quality, groundwater quality, water treatment systems, biomedical wastes treatment technologies and disposal options.

Unit III:

Solid waste, Definition and characteristics of industrial and hazardous wastes. Hazardous waste management, Solid Waste Management, Source classification and composition of MSW: Separation, storage and transportation, Reuse and recycling, Waste Minimization Techniques. Hazardous waste and their generation, Transportation and treatment: Incinerators, Inorganic waste treatment. E.I.A., Environmental auditing, Hazardous substances and risk analysis: Hazardous substance legislation, risk assessment, hazard deification, potential carcinogens, toxicity testing in animals, human exposure assessment.

Unit IV:

Air quality standards, emission standards,emission standards, criteria pollutants, air pollution and meteorology, atmospheric dispersion, emission controls. Air pollution and pollutants, criteria pollutants, Acid deposition, Global climate change –greenhouse gases, non-criteria pollutants, air pollution meteorology, Atmospheric dispersion. Industrial Air Emission Control. Flue gas desulphurization, NOx removal, Fugitive emissions.

B. Reading List:
Books:
1. G. Kiely,*"Environmental Engineering"* Irwin/ McGraw Hill International Edition, 1997.
2. Arcadio P. Sincero & Gergoria A. Since*ro, "Environmental Engineering"* Prentice Hall India
3. M. L. Davis and S. J. Masen, *"Principles of Environmental Engineering and Science",* McGraw Hill International Edition, 2004.
4. Curringham & Saigo*, "Environmental Science", TMH,*
5. Gilbert M. Masters & Wendell P. Ela, *"An Introduction to Environmental Engineering and Science",* PHI Publication.
6. Gilbert M Masters, *" Introduction to Environmental Engineering and Science"* Prentice Hall
7. J. G. Henry and G. W Heinke *"Environmental Science and Engineering"* Benjamin/Cummings Publishers
8. M.L. Davis and D.A. Cornwell *"Introduction to Environmental Engineering"* McGraw-Hill Education

Magazines:
1. *Applied Environmental Research Foundation*
2. *Environmental Science and Engineering*
3. *Climate Wire*
4. *Down to Earth*
5. *The Green Economist*
6. *Green Wire*

Journals:
1. *Journal of Environmental Science, Elsevier Publication*
2. *Environmental Science and Technology, ACS Publication*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

3. *Energy and Environmental Science, RSC Publication*
4. *Environmental International, Elsevier Publication*

Name of the Module: Engineering Physics - II
Module Code: PHY - 201
Semester: 2nd
Credit Value: 4 [P=2, T=0, L=3]

A. Objectives:
The course is design to meet with the objectives of:
1. Imparting theoretical & practical knowledge to the students in the area of Engineering Physics.
2. Providing teaching and learning to make students acquainting with modern state-of-art of Engineering
3. Injecting the future scope and the research direction in the field of Physics with specific specialization.
4. Making students competent to design & development of Engineering Physics.

B. Learning Outcomes:
Students successfully completing this module will be able to:
1. Students will be adequately trained to become Engineers.
2. Students will be substantially prepared to take up prospective research assignments Students will be substantially prepared to take up prospective research assignments.

C. Subject Matter:
Unit I:
   Electricity: Coulombs law in vector form, Electrostatic field and its curl, Gauss's law in integral form and conversion to differential form, Electrostatic potential and field, Poisson's Eqn. Laplace's Eqn. (Application to Cartesian, Spherically and Cylindrically symmetric systems-effective 1D problems)   Electric current, drift velocity, current density, continuity equation, steady state current Dielectrics- concept of polarization.

Unit II:
   Magnetostatics & time varying Field: Lorentz force, force on a small current element placed in a magnetic field, Biot-Savart law and its applications, divergence of a magnetic field, vector potential, ampere's law in integral form and conversion to differential form, Faraday's law of electromagnetic induction in integral form and conversion to differential form.

   Electromagnetic theory: conception of displacement current, Maxwell 's field equations, Maxwell's wave equation and its solution for fee space, E.M wave in a charge free conducting media, skin depth, physical significance of skin depth, E.M. energy flow & poynting vector.

Unit III:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

Syllabus for B-Tech (chemical engineering)

Quantum Mechanics: Wave particle duality, Compton effect, Photo electric effect, Black body radiation, Heisenberg's uncertainty relation, concept of wave packet. Conception of probability and probability density, operators, commutator, Formulation of quantum mechanics and basic postulates, Time dependent Schrodinger's equation, Formulation of Time independent Schrodinger's equation, physical interpretation of wave function, Free particle and particle in a box.

Unit IV:

Statistical Mechanics: Concept of energy levels and energy states. Microstates, macrostates and thermodynamic probability, equilibrium macrostate. MB, FD, BE statistics (No deduction necessary), fermions, bosons (definitions in terms of spin, examples), physical significance and application, classical limits of quantum statistics Fermi distribution at zero & non-zero temperature, Bose-Einstein statistics – Planck's law of blackbody radiation.

D. List of Practicals: (Minimum six experiments are required to be performed)
1. Determination of dielectric constant of a given dielectric material.
2. Determination of resistance of ballistic galvanometer by half deflection method and study of variation of   logarithmic decrement with series resistance.
3. Determination of specific charge (e/m) of electron by J.J. Thomson's method.
4. Determination of Planck's constant using photocell.
5. Determination of Rydberg constant by studying Hydrogen/ Helium spectrum.
6. Determination of Stefan's radiation constant.
7. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
8. Determination of Hall co-efficient of semiconductors.
9. Determination of band gap of semiconductors
10. Use of carry Foster's bridge to determine unknown resistance

E. Teaching/ Learning/ Practice Pattern:
 Teaching : 40%
 Learning : 10%
 Practice : 50%

F .Examination Pattern:
1. Theoretical Examination: Open book and on line.
2. Practical Examination: Conducting Experiment and Viva-Voce.

G. Reading Lists:
 Books
 1. Herbert Goldstein, Charles P. Poole and John Safko, *" Classical Mechanics"* 3rd edition, Pearson.
 2. N. C. Rana and P. S. Joag, *"Classical Mechanics",* Tata McGraw Hill Education Private Limited, New Delhi.
 3. D. Chattopadhyay and P. C. Rakshit, *"Electricity and Magnetism",* New Central Book Agency (P) Ltd.
 4. David J. Griffiths, *"Introduction to Electrodynamics,"* 3rd edition, PHI Learning Private Limited.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

5. W. H Hayt and J A Buck, *"Engineering Electromagnetics"* 7th edition, Tata McGraw Hill Education Private Limited, New Delhi.
6. Eisenberg and Resnick, *"Quantum Physics"*, 2nd edition, Wiley India.
7. F. Reif, *"Statistical Physics"* Tata McGraw Hill Education Private Limited, New Delhi.
8. S. N. Ghoshal, *"Atomic Physics"* S. Chand.
9. Beiser, Mahajan and Choudhury, *"Concepts of Modern Physics"* Tata McGraw Hill Education Private Limited, New Delhi.
10. A. B. Gupta, *"Modern Atomic and Nuclear Physics"* Books and Allied (P) Ltd.
11. Jeremy Bernstein, Paul M. Fishbane and Stephen G. Gasiorowicz *" Modern Physics"* Pearson.
12. Richard P. Feynman, Robert B. Leighton and Matthew Sands, *" The Feynman Lectures on Physics"* Vol. I to Vol. IV, Pearson.
13. D. Chattopadhyay and P. C. Rakshit, *"An Advanced Course in Practical Physics"* New Central Book Agency (P) Ltd.

Magazines:
1. *Resonance*
2. *American Teacher*
3. *Scientific Physics*
4. *Physics Today*
5. *Physics for You*

Journals:
1. *Nature*
2. *Physical Review Letter*
3. *Physical Review A & B*
4. *Applied Physics Letters (APL)*
5. *Proceedings of the National Academy of Sciences*
6. *Chemical Physics Letters*
7. *Journal of Physics: (Including A, B, C, D, E, F & G)*
8. *Journal of Scientific & Industrial Research*
9. *Indian Journal of Engineering & Material Sciences*
10. *Indian Journal of Radio and Space Physics*

Name of the Module: Digital Electronics & Logic Design
Module Code: ECE - 201
Semester: 2nd
Credit Value: 4 [P=2, T=0, L=3]

A. Objectives:

The course is designed to meet the objectives of:
1. To make the students to build a solid foundation about Boolean algebra
2. To make the students to study Digital Logic Gates and Circuits
3. To provide a clear foundation of Modern Digital System

B. Learning Outcomes:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

At the end of this module, students are expected to be able to
1. Clear understanding & utilization of logic gates
2. Design and develop of advanced TTL logic circuits
3. Utilization of Combinational and Sequential circuits, Counters, ADC and DAC

C. Subject Matter:

Unit I:

Number Systems: Decimal, Binary, Octal and Hexadecimal systems, conversion of a number from one base to another.

Codes: BCD, Excess- 3, Gray, Reflected, ASCII, EBCDIC.

Algebra for logic circuits: Logic variables; Logic constants; Logic functions- NOT, AND, OR, NAND, NOR, Ex-OR;

Combinational circuits: Full Adder / Subtractor, BCD Adder, LAC Adder, Comparator, Decoder, Encoder, Priority Encoder, MUX/DEMUX & there structures, Combinational logic design using ROM array, Applications of MSI designs.

Unit II:

Minimization Techniques & System Design: Basic models of sequential M/C, Analysis of Asynchronous and Synchronous circuits, Synthesis of completely and incompletely specified synchronous sequential M/Cs, Combination & Sequential Circuits. Boolean Algebra (including Shanon's expansion theorem and consensus theorem); Ven diagram representation, Canonical representations-min-term, max-term; Karnaugh map simplification, Quine Mc-clusky minimization. Minimization of Multiple Input and multiple Output system. Introduction to state machines. Classification of State Machines. State Machine Applications. Analysis of State Machine, State table, State Diagram, State Equation, State reduction and State assignment.

Unit III:

Other Gates & Circuits: Difference between combinational and sequential circuits,

Sequential Gates: Triggering of sequential logic circuits. Difference between flip flop and latch – Construction of RS, D, JK, JK master slave, T flip flops using basic gates, preset and clear signal,

Shift Registers: Serial in serial out – Serial in parallel out, Parallel in serial out, Parallel in parallel out, Universal Shift Registers & their Applications.

Counters: Asynchronous and synchronous counter, Ripple counter, Mod-N counter, Up-down counter, Ring counter, Johnson counter, Programmable counter – Applications. Design of Synchronous State Machine (including Counter) and Asynchronous state machine.

Unit IV:

Logic Families: Comparative studies of different type of logic families like RTL, Diode logic, DTL, TTL, IIL, HTL, ECL, MOS & CMOS etc. with the following characteristics: (a) logic levels, (b) power dissipation, (c) fan in and fan out, (d) propagation delay, and, (e) noise immunity.

Data Converters: Digital to Analog Converters: Binary weighted resistor type, R-2R ladder type, Specifications and applications of DA converter. Analog to Digital Converter: Comparator type, Successive approximation type, Dual slope AD converter, Specifications and applications of AD converter.

D. List of Experiments: (Minimum eight experiments should be conducted by students)

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

1. Study Data Hand Book and list at least 5 chips for each of primary, secondary gates & flip-flops and draw their diagram with pin configuration.
2. Verify Truth Table of NOT, 2-input AND and 2-input OR gate thereby inference.
   i) Single line definition of multiple input AND & OR gate.
   ii) What is the primary difference between NOT gate from AND & OR gate.
3. Study the Truth Table of the following by circuits.

   i)

   ii)
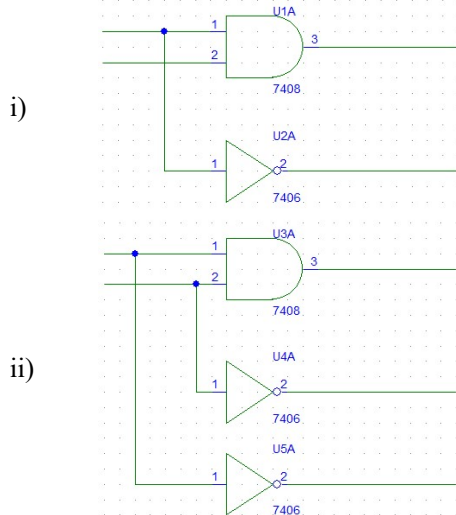
   iii) Compare the Truth Table of i) & ii) and that of AND gate and state inference.
4. Design Gray to Binary and Binary to Gray Converter & test
5. Design and test byte operated even parity generator & then convert it to odd parity generator.
6. Design and test (7,4) Hamming Code Generator and Error Correction decoder.
7. Design a Majority Gate and use it & a XOR gate to realize Adder Circuit & Verify.
8. With Serial Data input design a single circuit for test of >,<and =for two data.
9. Minimize the following logic system with SOP by tabular technique & implement the circuit.
   i) $f_1(A,B,C,D) = m_0 + m_1 + m_2 + m_3 + m_5 + m_6 + m_{10} + m_{13} + m_{15}$
   ii) $f_2(A,B,C,D) = m_0 + m_1 + m_2 + m_3 + m_5 + m_7 + m_{10} + m_{13}$
   iii) $f_3(A,B,C,D) = m_1 + m_2 + m_4 + m_5 + m_6 + m_7$
10. Minimize the following logic circuit defined in POS by tabular minimization technique:
    i) $f_1(X,Y,Z) = M_0.M_1.M_3.M_7$
    ii) $f_2(X,Y,Z) = M_0.M_1.M_2.M_6.M_7$
11. Write a C programmed to implement Tabular Technique for minimization of system as in problem (8)& (9)
12. Test Truth Table of
    i) S – R flip flop
    ii) J – K flip flop
    iii) D – flip flop
    iv) T – flip flop
13. Design 1 bit Read/Write memory with flip-flop and other logic gate & test.
14. Design Serial input & parallel output Shift register & test.
15. Design a binary counter & test.
16. Design one ADC &one DAC circuit & test.

E. Teaching/Learning/Practice Pattern:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

Syllabus for B-Tech (chemical engineering)

Teaching: 40%
Learning: 10%
Practice: 50%

F. Examination Pattern:
1. Theoretical Examination: Open book/ Regular examination and on line test.
2. Practical Examination: Conducting Experiment and Viva-Voice.

G. Reading List:
Books:
1. *J Crowe & B. Hayes-Gill, "Introduction to Digital Electronics", Newnes.*
2. *T. L. Floyd, "Digital Fundamentals"(9th Edition), Prentice Hall.*
3. Taylor L. Both, *"Introduction to Computer Engineering",* 3rd Ed., John Wiley & Sons
4. R. P. Jain*, "Modern Digital Electronics",* Tata McGraw Hill.
5. R L Morris & J R Miller, *"Designing with TTL integrated circuits",* McGraw Hill
6. C. H. Roth (Jr.), *"Fundamentals of Logic design",* Cengage Engineering.
7. M. Morris Mano, *"Digital Logic Design"*(3rd Edition), Prentice Hall.
8. Malvino & Leach*, "Digital Principles and Applications",* Tata McGraw Hill.
9. Anand Kumar*, "Fundamentals of Digital Circuits",* Prentice Hall.

Magazines:
1. *Planet Analog, http://www.planetanalog.com/*
2. *IEEE Spectrum, http://spectrum.ieee.org/*
3. *Electronics for you, EFY Enterprises Pvt. Ltd, New Delhi., http://www.electronicsforu.com/*
4. *Electropages, http://www.electropages.com/*

Journals:
1. *International Journal of Electronics Devices and Circuits.*
2. *IEEE Transaction on Computer-Aided Design of Integrated Circuits and System.*
3. *IEEE Transaction on Computer.*

Name of the Module: Historiography of Science & Technology
Module Code: HSS - 201
Semester: 2nd
Credit Value: 3[P=0, T=0, L=3]

A. Objectives:
The course is design to meet with the objectives of:
1. Providing teaching with inclusive learning.
2. Imparting theoretical lectures with case discussion.
3. Making students aware about the importance of this subject in their future career.

B. Learning Outcomes:
Students successfully completing this module will be able to:
1. Students will be to work with efficiency as they had knowledge of the subject.
2. With the backup knowledge their performance will definitely be much better in their workplace.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

C. Subject Matter:
Unit I
   Introduction: An overview: definitions, Different approaches to the scientific explorations, to introduce humanity's endeavour behind science and its application over the centuries, characteristics of histography of science and technology.

Unit II
   Motivation: Nature of drives, needs and motives, work motives, need of hierarchy theory and two factor theory of motivation, How to motivate the workers at work, factors effecting the morale of workers.
   Lives of Eminent Scientists: To understand the Background, Opportunities,   Achievements and Qualities in their efforts to become Scientist of first order.
   Scientific Eras: Course of Civilization and Scientific Endeavour.
   Contribution of science: Contribution to the present day World.
Unit III
   Answers to the Criticism that Science has created a World full of Pollutions

D. Teaching/Learning/Practice Pattern:
        Teaching: 40%
        Learning: 10%
        Practice: 50%
E. Examination Pattern:
           Theoretical Examination: Open book/ Regular examination and on line test.
F. Reading List:
   Books:
   1. Agassi, Joseph*, "Towards an Historiography of Science",* Wesleyan University Press. 1963.
   2. Kragh, Helge, *"An Introduction to the Historiography of Science", Cambridge* University Press. 1990.
   3. Kuhn, Thomas, *"The Structure of Scientific Revolutions, Chicago: University of Chicago, 1962 (third edn, 1996)".*
   4. *Gopala Krishnan, "K.V. Inventors Who Revolutionised Our Lives",* National Book Trust, India. 1999.
   Magazines:
   1.   *Science and Technology Magazine*
   2.   *Histograpghy of contemporary Science and Technology*
   3.   *Science News Letter*
   Journals:
   1. *Historiography in Graduate Technology*
   2. *Innovation, Technology or History*
   3. *Historiography of the Sciences*

Name of the Module: Basic Civil Engineering

Module Code: CE - 201
Semester: 2nd
Credit Value: 3 [P=0, T=0, L=3]

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

A. Objectives:

The course is design to meet with the objectives of:

1. Increase ability to understand Engineering Drawing.
2. Learn to sketch and take field dimensions.
3. Learn to take data and transform it into graphic drawings.
4. Learn basic engineering drawing formats.
5. Prepare the student for future Engineering positions.

B. Learning Outcomes:

Upon completion of the subject:

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.

C. Subject Matter:

Unit I:

Traditional Materials: stones, bricks, lime, cement, timber. Mortar: sand, cement mortar, mud mortar, special mortar, test on mortar Concrete: plain concrete, reinforced cement concrete, reinforced brick concrete

Unit II:

Metals as Building materials: Ferrous metals, aluminum, copper. Miscellaneous Building materials: Glass, plastics, bitumen, asbestos, paints, distempers, varnishes, solid and hollow concrete Blocks, Roofing and flooring tile

Unit III:

Superstructures: Types of superstructure based on the method of load transfer, walls, stone masonry, brick masonry, plastering, pointing, flooring, roof, doors and lintels, stairs.

Unit IV:

Surveying: Introduction to surveying-Object and uses of surveying, primary divisions of surveying, fundamental principles of surveying, classification of surveying, plans and maps, scales.

D.   Teaching/Learning/Practice Pattern:

Teaching: 40%
Learning: 10%
Practice: 50%

E.   Examination Pattern:

Theoretical Examination: Open book/ Regular examination and on line test.

F.   Reading Lists:
   Books:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

1. *Rakesh Roshan Beohar, "Basic Civil Engineering", Laxmi Publications.*
2. *Ramamurtham, "Basic Civil Engineering", Dhanpat Rai and sons*
3. *S SBhavikatti "Basic Civil Engineering" New Age international Publishers,*

Magazines:
1. *Civil Engineering and construction Review.*

Journals:
1. *ASCE*
2. *Springer.*

Name of the Module: Workshop Practice - II

Module Code: ME - 202
Semester: 2nd
Credit Value: 2 [P=3, T=0, L=0]

A. Objectives:
The course is design to meet with the objectives of:
1. To acquire skills in basic engineering practice.
2. To identify the hand tools and instruments.
3. To acquire measuring skills.
4. To acquire practical skills in the trades.
5. To acquire practical skills in welding, carpentry, fitting.

B. Learning Outcome:
Upon completion of the subject:
1. Should have knowledge of workshop safety.
2. Should have knowledge of Handling workshop tools, machines.
3. Should have knowledge of different welding types.
4. Should have knowledge of different carpentry joints.
5. Should have knowledge of different tools working principle.

C. Subject Matter:
Unit I:

Bench work and Fitting: Tools for laying out, chisels, files, hammers, hand hacksaw, their specifications and uses, plumbing, Sheet metal Work.

Unit II:

Metal Joining: Definitions of welding, brazing and soldering processes, and their applications. Oxy acetylene gas welding process, equipment and techniques. Types of flames and their applications. Manual metal arc welding technique and equipment.AC and DC welding, electrodes, constituents and functions of electrodes. Welding positions. Types of weld joint. Common welding defects such as cracks, slag inclusion and porosity.

Unit III:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Machine Shop: Introduction, Basic Principles of Lathe, Shaper, Milling, Drilling, Grinding, Power Hacksaw,etc.

D. List of Practicals:
1. To practice Gas welding using a 3mm thick mild steel plate. (Welding Shop)
2. To prepare a Lap joint and Butt joint by Gas Welding from 3mm thick mild steel plate (Welding Shop).
3. To practice Manual metal arc welding using a 5mm thick mild steel plate (Welding Shop).
4. To prepare various patterns using wood as a pattern material with the help of specific tools. (Carpentry Shop)
5. To perform various bench working operations like sawing, filling and finishing on a 5mm thick mild steel plate using specific tools (Fitting Shop).
6. To prepare jobs (Square, Angular and Semi Circular grooves) using 5mm mild steel plate using specific tools (Fitting Shop)
7. T-Lap joint and Bridle joint (Carpentry Shop).
8. Gas Welding practice on mild steel flat/sheet upto 3 mm thick.
9. Lap joint by Gas Welding (upto 3mm thick).
10. Manual Metal Arc Welding practice (upto 5mm thick).
11. Pattern Making. (Carpentry Shop)
12. Laying out (bench work); Sawing and Finishing by Filing.

E. Teaching/Learning/Practice Pattern:
Teaching: 20%
Learning: 20 %
Practice: 60%

F. Examination Pattern:
1. Job making.
2. Viva-voce.

G. Reading Lists:
Books:
1. M.L. Begeman and B.H. Amstead, *"Manufacturing Process"* John Wiley, 1968.
2. W.A.J. Chapman and E.Arnold, *"Workshop Technology"* Vol. 1, 2 & 3, CRC press Prentice Hall
3. B.S. Rghuwanshi, *"Workshop Technology"* Vol. 1 & 2 – Dhanpat Rai and Sons.
4. Hazra and Choudhary*,"Workshop Technology"* Vol. 1, 2, Media Promoters
5. Virender Narula *"Workshop Technology",* S.K.Kataria & Sons
6. Anderson, *"Shop Theory"* McGraw Hill.
7. H.S. Bawa, *"Carpentry: A Complete Guide",* Tata McGraw Hill.
8. R. Little, *"Welding & Welding Technology",* Tata McGraw Hill.
9. L.M.Gourd, *"Principles of welding technology",* Edward Arnold Publishers.
10. R.S.Parmer, *"Welding processes and technology"* Khanna Publication.

Magazines:
1. *International Metal Working News.*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

2. *Industrial Distribution*

Journals:
1. *International Journal of Machine Tools and Manufacture*
2. *Journal of Manufacturing Science and Engineering, Transactions of the ASME*
3. *Journal of Manufacturing Technology and Research*

Name of the Module: Foreign Language (French) (Audit)
Module Code: HSS - 202
Semester: 2nd
Credit Value: 0 [P=2, T=0, L=0]

A. Objectives:
The course is design to meet with the objectives of:
1. The French Language course accords to a method created for Indian students who are complete beginners in French and who wish to acquire verbal communication skills in current scenario.

B. Learning Outcomes:
Students successfully completing this module will be able to :
1. Develop four skills in French i.e. Reading, Writing, Speaking, Comprehension

C. Subject Matter:
Unit-I:
Self Introduction, Introducing Friends, Family &persons Topical writing, Essays Description of persons Place, Things, Class, City, Country, House, Plan a Week-End, Excursion,
Unit-II:
Making Resume , Interviews Letter Writing , Rejecting or accepting proposals. Invitation, Dialogues, Tastes & Preferences
Unit-III:
Conversational French between Known & Unknown people, Telephonic Conversation with Friends & Client

D. List of Practicals:
1. Issue Writing
2. Writing Resumes and Applications
3. Writing Memos
4. Reading Comprehension
5. Vocabulary
6. Presentation Skills
7. Group Discussion
8. Extempore
9. Debates

E. Teaching/ Learning/ Practice Pattern:
Teaching: 40%
Learning: 10%

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Practice: 50%

F. Examination Pattern:

1. Theoretical Examination

G. Reading List:

Books:

Suggested book -Ailes Volume-II

Semester III

Subject Code	Subject	P	T	L	Credit
CHE - 301	Chemical Engineering Thermodynamics	0	1	3	4
CHE - 302	Fluid Mechanics	0	0	3	3
CSE - 302	Data Structure & algorithm	2	0	3	4
CHE - 303	Physical Chemistry	0	0	3	3
MAS - 301	Discrete Mathematics	0	1	3	4
HSS - 301	Behavioral Science	0	0	2	2
CHE - 304	Instrumental Analysis	3	0	0	3
CHE - 305	Numerical Methods in Chemical Engineering	0	1	3	4
HSS - 302	Yoga	2	0	0	1
		7	**3**	**20**	**28**

Name of the Module: Chemical Engineering Thermodynamics
Module Code: CHE - 301
Semester: 3ʳᵈ
Credit Value: 4 [P = 0, T = 1, L = 3]

A. Objectives:

Students will learn PVT behaviour of fluids, thermodynamic property relations and their applications to phase equilibria and chemical reaction equilibria.

B. Subject Matter

Unit I:

Volumetric Properties of pure fluids: Equations of State (EOS); Thermodynamic property relations for homogenous phase of constant composition: Maxwell Relations, Relation of thermodynamic potentials with measurable properties; Clapeyron equation; Kirchhoff relation, Residual properties and estimation from EOS, thermodynamic diagrams; estimation of fugacity and fugacity coefficient.

Unit II:

Solution Thermodynamics: partial properties, relation between molar and partial properties, relation among partial properties, chemical potential, Ideal gas mixtures; fugacity coefficient of species in solution and estimation, Ideal solution model,

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Lewis-Randall rule, Henry's Law; Excess property relations, Excess property and activity coefficient, Excess Gibbs free energy models; property changes of mixing.

Unit III:

Phase Equilibria: equilibrium and stability, chemical potential and phase equilibria; Gibbs' phase rule; Vapor/Liquid equilibrium; Liquid/Liquid equilibrium; Solid/liquid equilibria; Equilibrium adsorption of gases on solid; dilute solution.

Unit IV:

Chemical Reaction Equilibria: Effect of operating conditions on equilibrium conversion; determination of equilibrium compositions for homogeneous gas-phase reactions - single and multiple reactions.

C. Reading List:
  Books
1. Smith, J.M., Van Ness, H.C and Abbot M.M *"Introduction to Chemical Engineering Thermodynamics ",* McGraw Hill Publishers, VI edition, 2003
2. Narayanan, K.V. *" A Textbook of Chemical Engineering Thermodynamics",* Prentice Hall India, 2004
3. Kyle, B.G., *"Chemical and Process Thermodynamics III Edition",* Prentice Hall of India Pvt. Ltd., 1999.
4. Elliott J.R., Lira, C.T*., "Introductory chemical engineering thermodynamics",* Prentice *Hall, 1998*
5. Rao, Y.V.C., *"Chemical Engineering Thermodynamics"* Universities Press, 2005
6. Pradeep Ahuja, *"Chemical Engineering Thermodynamics",* PHI Learning Ltd, 2009).
7. Gopinath Halder*, "Introduction to Chemical Engineering Thermodynamics",* PHI Learning Ltd (2009).

  Journals:
1. *Journal of Chemical and Engineering Data, ACS publication*
2. *Chemical Engineering Science, Science Direct*
3. *The Journal of Chemical Thermodynamics - Elsevier*

  Magazines:
1. *Introductory Chemical Engineering Thermodynamics 2nd Edition*
2. *Chemical Engineering: An Introduction*
3. *Introduction to Chemical Engineering Thermodynamics*

Name of the Module: Fluid Mechanics
Module Code: CHE - 302
Semester: 3rd
Credit Value: 3 [P = 0, T = 0, L = 3]

  a. **Objectives:**
  • The nature of fluid, different types of flow of fluid, conservations of mass and momentum.
  • To apply Bernoulli's equation to solve different problems.
  • Flow of fluid through pipes and conduits – friction factor & its relation with Reynold's number.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

- Flow of compressible fluid and related aspects.

Unit I

Fluid, Concept of continuum, Velocity field, Streamlines, Streaklines, Pathlines, Timelines, Stress field, Viscosity, Newtonian fluid and non-Newtonian fluids, Description and Classification of fluid flow; Fluid Statics: Pressure variation in a static fluid.

Unit II

Control volume analysis (integral approach): Reynolds transport theorem, conservation of mass and momentum.

Differential analysis of fluid motion: Conservation of mass; Stream function for two-dimensional incompressible flow, Momentum Equation for frictionless flow, Bernoulli equation. Static, Stagnation and Dynamic pressures. Fluid machineries.

Incompressible viscous flow through pipes and conduits - laminar and turbulent flow, and boundary layer flow. Corrections to Bernoulli's equation, friction factor, major and minor frictional losses.

Unit III

External flows: Boundary layer - Drag and lift, Drag coefficient & its relation with Reynold's number. Flow measuring devices.

Unit IV

Compressible Flow –isoentropic flow, adiabatic flow, fannoline, isothermal , Rayleigh line, normal shock in duct, ideal gas.

G. Reading Lists:
  Books:
  1. W.L. McCabe, J.C. Smith and P. Harriott, "*Unit Operations of Chemical Engineering*", 7th Edition, McGraw Hill, 2005.
  2. "*Introduction to Fluid Mechanics*" by Fox and McDonald
  3. Fundamentals of Fluid Mechanics – Philip M. Gerhart, Richard J. gross, John I. Hochstein
  4. Fluid Mechanics – Victor L. Streeter
  5. Fluid Mechanics and its Application – Vijay Gupta & Santosh K. Gupta
Journals:
  1. *Journal of Fluid Mechanics*
  2. *Journal of Fluid Flow*
  3. *Journal of Chemical & Engineering Data*
Magazines:
  1. *Chemical Engineering World (CEW)*
  2. *Chemical Process Safety*

Name of the Module: Data Structure & Algorithm
Module Code: CSE - 302
Semester: 3rd
Credit Value: 4[P = 2, T = 0, L = 3]

  A. Objectives:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

The course is design to meet with the objectives of:

1. To extend student's Logical and Mathematical maturity and ability to deal with abstraction and to introduce most of the basic terminologies used in computer science courses and application of ideas to solve practical problems.
2. Apply logical reasoning to solve a variety of problems.

B.   Learning Outcomes:

Upon completion of the subject:

1. Students will have acquired greater precision in logical argument and have gained a core mathematical understanding of discrete mathematics.
2. Students will have learned and practised basic concepts of mathematical proof (direct proof, proof by contradiction, mathematical induction).
3. Students will be able to handle the standard logical symbols with some confidence.
4. Students will have learned elementary combinatorial and counting techniques and how to apply them to simple problems.
5. Students will be able to simplify complex mathematical expressions and apply general formulae to specific contexts.
6. Students will have learned how to state precisely and prove elementary mathematical statements and solve problems.
7. Students will have a basic understanding of information technology and its use in mathematical contexts.

C.   Subject Matter:

Unit 1:

Sets and Properties: Finite and Infinite Sets, Combinations of Sets, Unaccountably Infinite Sets, Mathematical Induction, Principle of Inclusion and Exclusion , Multisets, Propositions.

Permutations, Combinations, and Discrete Probability: The Rules of Sum and Product, Permutations, Combinations, Generation of Permutations and Combinations, Discrete Probability, Conditional Probability, Information and Mutual Information.

Relations and Functions : A Relational Model for Data Bases, Properties of Binary Relations, Equivalence Relations and Partitions, Partial Ordering, Relations and Lattices, Chains and Antichains, A Job-Scheduling Problem, Functions and the Pigeonhole Principle.

Unit II:

Graphs and Planar Graph: Basis Terminology, Multigraphs and Weighted Graphs, Paths and Circuits, Shortest Paths in Weighted Graphs, Eulerian Paths and Circuits, Hamiltonian Paths and Circuits, The Traveling Salesperson Problem.

Trees and Cut-Sets: Trees, Rooted Trees, Path Lengths in Rooted Trees, Prefix Codes, Binary Search Trees, Spanning Trees and Cut-Sets, Minimum Spanning Trees.

Unit III:

Discrete Numeric Functions and Generating Functions: Manipulation of Numeric Functions, Asymptotic Behavior of Numeric Functions, Generating Functions, Combinatorial Problem.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Recurrence Relations and Recursive Algorithms: Recurrence Relations, Linear Recurrence Relations with Constant Coefficients, Homogenous Solutions, Particular Solution.

Unit IV:

Group and Rings : Groups, Subgroups, Generators and Evaluation of Powers, Cosets and Lagrange's Theorem, Permutation Groups and Burnside's Theorem, Codes and Group Codes, Isomorphisms and Automorphisms, Homomorphisms and Normal Subgroups, Rings, Integral Domains, and Fields.

Boolean Algebra: Lattices and Algebraic Systems, Principle of Duality, Basic Properties of Algebraic System, Defined by Lattices, Distributive and Complemented Lattices, Boolean Lattices and Boolean Algebras, Uniqueness of Finite Boolean Algebras, Boolean Functions and Boolean Expressions, Propositional Calculus.

D. Teaching/ Learning/ Practice Pattern:

Teaching: 70%

Learning: 30%

Practice: 0%

E. Examination Pattern:

Theoretical Examination:

F. Reading Lists:

Books:

1. C.L. Liu, *"Elements of Discrete Mathematics",* Tata Mc Graw Hill, 2011.
2. Kolman B, Busby R. C, Ross S.C, *"Discrete Mathematical Structures",* PHI Learning, 2011.
3. D.S Malik & M.K.Sen*, "Discrete Mathematical Structures: Theory & Applications",* Thomson India Edition, 2004.
4. T. Veerarajan, *"Discrete Mathematics",* Mc Graw Hill, 2012.
5. N. Chandrasekaran, M. Umaparvathi, *"Discrete Mathematics",* PHI Learning Private Limited, 2010.
6. Babu Ram, *"Discrete Mathematics",* Pearson, 2011.
7. S. Lipschutz, Marc L. Lipson, *"Discrete Mathematics",* Schaum's Outlines*,* Tata Mc Graw Hill, 2010.
8. Norman L. Biggs, *"Discrete Mathematics",* Oxford, 2nd Edition, 2009.
9. S. K. Chakraborty, B. K. Sarkar, *"Discrete Mathematics",* Oxford University Press, 2011.
10. K. D. Joshi, *"Applied Discrete Structures",* New Age International Publishers, 2003.
11. Rowan Garnier & John Taylor, *"Discrete Mathematics",* CRC Press, 2011.
12. R. Johnsonbaugh, *"Discrete Mathematics",* Pearson, 2011.

Magazines:

1. *Current Science (Indian Academy of Science)*
2. *The Mathematics Student (Math Student) (Indian Mathematical Society)*
3. *Mathematical Spectrum(The University of Sheffield)*
4. *Mathematics Magazine (Mathematical Association of America)*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

5.   *+Plus magazine (University of Cambridge)*
6.   *Ganithavahini (Ramanujan Mathematical Society)*
7.   *Mathematics Today, London Metropolitan University.*

Journals:
1.   *SIAM Journal on Discrete Mathematics.*
2.   *Open Journal of Discrete Mathematics. Website: http:// www. scirp. org/journal/ojdm/*
3.   *Discrete Mathematics, Elsevier.*
4.   *Journal of Discrete Mathematics, Hindawi Publishing Corporation.*

Name of the Module: Physical Chemistry
Module Code: CHE - 303
Semester: 3rd
Credit Value: 3 [P = 0, T = 0, L = 3]

A.   Subject Matter:

Unit I

Electrochemistry: Electrolytic conductance, Transference Number, Specific and Equivalent Conductance-Debye-Huckel, Onsager relations-absolute velocity of ions, degree of ionization and conductance, application of conductance, concept of activity and activity coefficient

Unit II

Cells (reversible and irreversible cells), electromotive force, standard cells, cell relation and electromotive force (EMF), convention on the sign of EMF, single electrode potential, calculation of cell EMF from single electrode potential, thermodynamics of electrode potentials (electromotive series, standard electrode potentials) equations for cell EMF, standard potentials and equilibrium constants, types of electrodes (hydrogen and calomel electrodes in particular)

Electrochemical Cells Application: solubility product and EMF, potentiometric determination of pH, potentiometric titration, electrolysis and polarization, decomposition potential, overvoltage (its measurement), electrolytic separation of metals, commercial cells, fuel cells.

Unit III

Surface Chemistry: Surface tension, surface energy, pressure differential across a curved surface and capillary rise and fall, Kelvin equation, Gibbs monolayer and Gibbs equation, and surface energy micro heterogeneous systems and their uses, contact angle, wetting, spreading and adhesion, adsorption and colloidal dispersions, types of colloids, colloid solubility, concept of zeta potential and electrokinetics, nano dispersions, their preparation, synthesis and uses.

Unit IV

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Physics of surfaces Surface and Interface- molecular origin, the work of cohesion and adhesion Interaction forces and potential, chemical and physical interaction, classification of physical forces. interaction between surface and particles – Lifshitz theory, hydrodynamic flow effects in interfacial interactions Electrostatics forces and electric double layer, DLVO theory.

B. Reading Lists:
   Books:

1. *Rakshit P. C., "Physical Chemistry", Sarat Book Distributor.*
2. *Glasston Samuel, " Text Book of Physical Chemistry", New York, D. Van*
3. *Nostrand company.*
4. *Maity and Maity , "Engingeering Chemistry",U & N Dhar Publisher.*
5. *Ray, Das, Biswas, "Engingeering Chemistry", New Central Book Agency.*
6. *Levine, "Physical Chemistry", McGraw-Hill Education.*

  Journals:

1. *Journal of Physical Chemistry, ACS*
2. *Journal of Electrochemistry*
3. *Material Science & Engineering B, Elsevier*
4. *Applied Physics Letters (APL)*
5. *Chemical Physics Letters*
6. *Journal of Physics*
7. *Journal of Scientific & Industrial Research*
8. *Indian Journal of Engineering & Material Sciences*

  Magazines:

1. *Chemical Science*
2. *Chemistry Today*
3. *Chemistry For You*
4. *Scientific Physics*

Name of the Module: Discrete Mathematics
Module Code: MAS - 301
Semester: 4th
Credit Value: 4[P = 0, T = 1, L = 3]

A. Objectives:
The course is design to meet with the objectives of:

1. To extend student's Logical and Mathematical maturity and ability to deal with abstraction and to introduce most of the basic terminologies used in computer science courses and application of ideas to solve practical problems.
2. Apply logical reasoning to solve a variety of problems.

B.   Learning Outcomes:
Upon completion of the subject:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

1. Students will have acquired greater precision in logical argument and have gained a core mathematical understanding of discrete mathematics.
2. Students will have learned and practised basic concepts of mathematical proof (direct proof, proof by contradiction, mathematical induction).
3. Students will be able to handle the standard logical symbols with some confidence.
4. Students will have learned elementary combinatorial and counting techniques and how to apply them to simple problems.
5. Students will be able to simplify complex mathematical expressions and apply general formulae to specific contexts.
6. Students will have learned how to state precisely and prove elementary mathematical
7. statements and solve problems.
8. Students will have a basic understanding of information technology and its use in
   a. mathematical contexts .

C. Subject Matter:

Unit I:

Sets and Properties: Finite and Infinite Sets, Combinations of Sets, Unaccountably Infinite Sets, Mathematical Induction, Principle of Inclusion and Exclusion , Multisets, Propositions.

Permutations, Combinations, and Discrete Probability: The Rules of Sum and Product, Permutations, Combinations, Generation of Permutations and Combinations, Discrete Probability, Conditional Probability, Information and Mutual Information.

Relations and Functions : A Relational Model for Data Bases, Properties of Binary Relations, Equivalence Relations and Partitions, Partial Ordering, Relations and Lattices, Chains and Antichains, A Job-Scheduling Problem, Functions and the Pigeonhole Principle.

Unit II:

Graphs and Planar Graph: Basis Terminology, Multigraphs and Weighted Graphs, Paths and Circuits, Shortest Paths in Weighted Graphs, Eulerian Paths and Circuits, Hamiltonian Paths and Circuits, The Traveling Salesperson Problem.

Trees and Cut-Sets: Trees, Rooted Trees, Path Lengths in Rooted Trees, Prefix Codes, Binary Search Trees, Spanning Trees and Cut-Sets, Minimum Spanning Trees.

Unit III:

Discrete Numeric Functions and Generating Functions: Manipulation of Numeric Functions, Asymptotic Behavior of Numeric Functions, Generating Functions, Combinatorial Problem.

Recurrence Relations and Recursive Algorithms: Recurrence Relations, Linear Recurrence Relations with Constant Coefficients, Homogenous Solutions, Particular Solution.

Unit IV:

Group and Rings : Groups, Subgroups, Generators and Evaluation of Powers, Cosets and Lagrange's Theorem, Permutation Groups and Burnside's Theorem, Codes and Group Codes, Isomorphisms and Automorphisms, Homomorphisms and Normal Subgroups, Rings, Integral Domains, and Fields.

Boolean Algebra: Lattices and Algebraic Systems, Principle of Duality, Basic Properties of Algebraic System, Defined by Lattices, Distributive and Complemented Lattices, Boolean Lattices and Boolean Algebras, Uniqueness of Finite Boolean Algebras, Boolean Functions and Boolean Expressions, Propositional Calculus.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

a. Teaching/ Learning/ Practice Pattern:

Teaching: 70%

Learning: 30%

Practice: 0%

E. Examination Pattern:

1. Theoretical Examination:

F. Reading Lists:

Books:

1. C.L. Liu, "Elements of Discrete Mathematics", Tata Mc Graw Hill, 2011.
2. Kolman B, Busby R. C, Ross S.C, "Discrete Mathematical Structures", PHI Learning, 2011.
3. D.S Malik & M.K.Sen, "Discrete Mathematical Structures: Theory & Applications", Thomson India Edition, 2004.
4. T. Veerarajan, "Discrete Mathematics", Mc Graw Hill, 2012.
5. N. Chandrasekaran, M. Umaparvathi, "Discrete Mathematics", PHI Learning Private Limited, 2010.
6. Babu Ram, "Discrete Mathematics", Pearson, 2011.
7. S. Lipschutz, Marc L. Lipson, "Discrete Mathematics", Schaum's Outlines, Tata Mc Graw Hill, 2010.
8. Norman L. Biggs, "Discrete Mathematics", Oxford, 2nd Edition, 2009.
9. S. K. Chakraborty, B. K. Sarkar, "Discrete Mathematics", Oxford University Press, 2011.
10. K. D. Joshi, "Applied Discrete Structures", New Age International Publishers, 2003.
11. Rowan Garnier & John Taylor, "Discrete Mathematics", CRC Press, 2011.
12. R. Johnsonbaugh, "Discrete Mathematics", Pearson, 2011.

Magazines:

1. Current Science (Indian Academy of Science)
2. The Mathematics Student (Math Student) (Indian Mathematical Society)
3. Mathematical Spectrum(The University of Sheffield)
4. Mathematics Magazine (Mathematical Association of America)
5. +Plus magazine (University of Cambridge)
6. Ganithavahini (Ramanujan Mathematical Society)
7. Mathematics Today (London Metropolitan University).

Journals:

1. SIAM Journal on Discrete Mathematics.
2. Open Journal of Discrete Mathematics. Website: http:// www. scirp. org/journal/ojdm/
3. Discrete Mathematics, Elsevier.
4. Journal of Discrete Mathematics, Hindawi Publishing Corporation.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Name of the Module: Behavioural Science
Module Code: HSS - 301
Semester: 3rd
Credit Value: 2 [P = 0, T = 0, L = 2]

A. Objectives:

The course is design to meet with the objectives of:
1. Imparting theoretical lectures with case discussion.
2. Providing teaching with inclusive learning.
3. Making students aware about the importance of this subject in their future career.

B. Subject Matter:
Unit I:

Behavioral Science: An overview: definitions, Man the critical factor, Behavioral science and its historical development. **Motivation**: Nature of drives, needs and motives, work motives, need hierarchy theory and two factor theory of motivation, how to motivate the workers at work, factors effecting the morale of workers.

Unit II:

Industrial Sociology: Concept and Definitions; Importance for Engineers; Growth; Criticism of the Hawthorne Studies; Nature and scope of Industrial sociology, Industry and Community, Industry and Tradition in India.

Society and Technical Change: Concept of social change, meaning and definitions of social change, nature of social change. Factors such as Natural, Cultural, Economic, Planning, Technological, Indian Information Technology Scenario, Effect of Technology on Social Institutions. **Society and Environment**: Meaning and Definitions, Characteristics, Classification of Environment, Physical Environment and its Influence, Social Environment and its some basic elements, Environment in Industry, Illumination, Noise, Atmospheric Conditions, Music and Colour.

Unit III:

Groups: Meaning and Definitions, types of Groups, characteristics, functions of formal and informal groups, merits and demerits of informal groups.

Unit IV:

Human relations: Historical overview, definitions, early and later approaches to human relations, strategies for establishing healthy human relations. **Labour management relations**: Industrial relations; meaning, objectives and definitions, Dunlop's theory of industrial relations, Psychological and Gandhian approach to industrial relations, industrial relations in Japan and India, industrial relation in coming years, challenges of coming years, new dimensions of industrial relations, the ways of industrial peace. Trade unions; meaning and definitions, functions of Indian trade Unions, recent emerging trends in Indian trade unions.

C. Teaching/ Learning Pattern:
1. Teaching : 50%
2. Learning/ case presentation : 30%
3. Assignment : 10%
4. Attendance : 10%

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

D. Examination Pattern:
1. Theoretical Examination : 50
2. Class test : 30
3. Assignment : 20

E. Reading Lists:
   Books:

1. Wendell L. French*, "Human Resource Management",* (4th ed.) Proston: Honshto Mittin, 1998.
2. H.Fayol*, "Industrial and General Administration",* Paris: Dunod, 1916.
3. Mintzberg, *"The Nature of Managerial Works: Upper Saddle River",* N.J Printice Hall, 1973.
4. Fred N.Ker Linger, *"Behavioral Research: A conceptual Approach",* New York:Holt Rinehart and Winston,1979
5. Milter William R. And Stephen Rollnick, *"Motivational Interviews",* (3rd ed.), Sept 7, 2012.
6. Daniel Kahnmen*, "Thinking Fast and Slow",* April 2, 2013.
7. Elizabeth, D. Hutchison*," Essentials of Human Behaviour",* September 3, 2013.
8. Susan P.Robbins, Pranal Chatterjee, Edward R.Canda, *"Contemporary Human Behaviour Theory",* 2013.
   Magazines:
1. *Leadership Quarterly*
2. *HBR Magazine*

   Journals:
1. *Journal of Behavioral Sciences*
2. *Behavioral and Brain Sciences*
3. *Journal of Contextual Behavioral Sciences*
4. *Harvard Business Review*

Name of the Module: Instrumental Analysis
Module Code: CHE - 304
Semester: 3rd
Credit Value: 3 [P = 3, T = 0, L = 0]

A. Subject Matter:
1. Detection and estimation of compounds present in liquid samples using UV-VIS Spectrophotometer
2. Separation of liquids from different mixtures and their quantification using Thin Layer Chromatography, Gas-liquid Chromatography and Paper Chromatography.
3. Analysis of Chromium, Lead, Arsenic, Copper, etc. in water/liquid effluents using Atomic Absorption Spectrophotometer (AAS)
4. Use of HPLC for estimation of compounds present in Vegetable oil/Mineral oil
5. Detection and estimation of compounds present in liquid effluents using FTIR.
6. Estimation of protein using TOC Analyzer

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

B. Reading Lists:
Books:
1. *Gupta M.C. , "Atomic & Molecular Spectroscopy", New Age.*
2. *Kalsi P.S, "Spectroscopy of Organic Compounds", New Age.*
3. *Ray, Das, Biswas, "Engingeering Chemistry", New Central Book Agency.*
4. *Vogel, "Organic Analysis"*

Magazines:
1. *Operating Manuals of AAS, UV-Vis Spetrophotometer, FTIR*
2. *Operation Manuals of GC, HPLC, TLC, PC*

Journals:
1. *Journal of Organic Chemistry, ACS*
2. *Journal of Physical Chemistry, ACS*

Name of the Module: Numerical Methods in Chemical Engineering
Module Code: CHE - 305
Semester: 3rd
Credit Value: 4 [P = 0, T = 1, L = 3]

A. Objectives:
Students will be able to develop methodologies for solving a wide variety of practical engineering problems, and to provide useful information concerning the performance and design of particular systems and processes

B. Subject Matter:

Unit I

Linear Algebraic Equations: Gaussian elimination, Thomas algorithm, Cholesky and Crout LU decomposition methods, Determination of inverse of a matrix: Gauss-Jordan method; Jacobi method; Gauss-Seidel method; Relaxation method. Eigenvalues and Vectors of Matrixes: Power method, Householder's method

Unit II

Nonlinear algebraic equations: Bisection method, Successive substitution, Regula falsii method, Newton-Raphson method, Error analysis for Iterative Methods, Extension to multivariable, Determination of roots of a polynomial.

Function approximation: Least Squares, Extension to multivariable. Interpolation: Newton's Forward, Backward and Divided Difference polynomial, Lagrangian Interpolation; Pade approximation; Cubic spline. Numerical Differentiation . Numerical integration - Trapezoidal rule, Simpson's rule, Gaussian quadrature.

Unit III

Ordinary Differential Equations: (Initial Value Problem)-Explicit and Implicit Methods - Euler's, Taylor, Runge-Kutta, and multistep methods. Estimation of error, Stability.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Boundary Value Problem (BVP): Finite Difference Methods, Orthogonal Collocation, Shooting Method, Extension to multi-variable ODE

Unit IV

Partial Differential Equations: Application of Finite Difference method for solution of Parabolic and Elliptic partial differential equations. Extension to multi-variable PDE.

C. Reading Lists:
  Books:
1. *Numerical Methods for Scientific and Engineering Computation by M.K. Jain, S.R.K. Iyengar, R.K. Jain.*
2. *Numerical methods for engineers by Santosh K. Gupta.*
3. *Nonlinear Analysis in Chemical Engineering, Bruce A. Finlayson.*

Journals:

Magazines:

Semester IV

Subject Code	Subject	P	T	L	Credit
CHE - 401	Chemical Process Technology - I	0	0	3	3
CHE - 402	Mechanical Operation	0	1	3	4
CHE - 403	Heat Transfer	0	1	3	4
MAS - 401	Stochastic Processes	0	1	3	4
CHE - 404	Process Control	0	1	3	4
CHE - 405	Fuel and Combustion	0	0	3	3
CHE - 406	Numerical Methods Laboratory	3	0	0	3
CHE - 407	Fluid Mechanics Laboratory	3	0	0	3
		6	**4**	**18**	**28**

Name of the Module: Chemical Process Technology - I
Module Code: CHE - 401
Semester: 4th
Credit Value: 3[P = 0, T = 0, L = 3]

  A. Objectives:
  Students will study

1. Chemical process technologies of various inorganic process industries.

2. Develop process flow diagram of the processes

3. Provide useful information concerning the performance and design of particular processes.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

B. **Subject Matter:**

Unit I

Typical chemical processes: unit operations and unit processes; classification of Indian chemical process industry; inorganic chemical industry; study aspects of a CPI- raw materials, process, chemical reactions, process and block flow diagram, major engineering issues and uses; Water conditioning and treatment processes, softening and demineralization of water; air conditioning and treatment processes, air liquefaction: Claude and Linde processes.

Unit II

Chemicals from sea water. Common salt (NaCl) manufacture: solar and vacuum evaporation methods. Manufacture of various industrial gases: carbon dioxide, hydrogen, oxygen, nitrogen, helium, acetylene, carbon monoxide and sulphur dioxide.

Unit III

Amorphous and crystalline forms of carbon, manufacture and applications of lamp black, carbon black and graphite; activated carbon and its manufacture by gaseous oxidation and chemical activation methods. Various kinds of cements and their major constituents, cement manufacture by cement rock (limestone) beneficiation and Portland process. Nature, types, composition and uses of glass, its manufacture: melting, shaping, annealing and finishing operations; Fourcalt and float glass processes.

Unit IV

Raw materials, methods used in chlor-alkali industry- Sodium hydroxide, Chlorine, Sodium hypochloride, Bleaching powder, hydrochloric acid. Manufacture of phosphatic fertilizers: calcium phosphates, ammonium phosphate, nitro phosphate and sodium phosphate. Manufacture of ammonia, urea, nitric acid and ammonium nitrate. Sulphur-its forms, properties and sources, sulphur mining by Frasch process, sulphur recovery from pyrite ore by Finnish process, sulphur recovery from natural gas and petroleum refinery streams by Claus process; sulphuric acid manufacture by Contact process.

C. **Reading Lists:**
   Books:
   1. *"Dryden's Outlines of Chemical Technology", Edited by M. Gopala Rao, M. Sittig, Affiliated East-West Press Ltd*
   2. *G.T. Austin, Shreve's "Chemical Process Industries", Mc Graw Hill.*
   Journals:
   1. *Combustion and Flame, Science Direct*
   2. *Journal of Chemical Engineering & Process Technology, J Scholar*
   Magazines:
   1. *Chemical Engineering Magazine*
   2. *Chemical Engineering*

Name of the Module: Mechanical Operation
Module Code: CHE - 402
Semester: 4th
Credit Value: 4[P = 0, T = 1, L = 3]

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

Syllabus for B-Tech (chemical engineering)

A. Objectives: In this course, the students will learn characterization of solids, size reduction, techniques of solid – fluid separation and mixing.

B. Subject Matter:

Unit I

Introduction: Unit operations and their role in chemical industries. Properties and handling of particulate solids: Characterization of solid particles, Properties of masses of particles, Mixing of solids. Size reduction: Laws of size reduction, energy relationships in size reduction, power requirement, work index. Methods of size reduction, classification of equipment - crushers, grinders, disintegrators for coarse, intermediate and fine grinders, Ultrafine grinders. Size enlargement-principle of granulation, briquetting, pelletisation, and flocculation.

Unit II

Gravity settling: Free and Hindered settlings, sedimentation, thickening, elutriation, double cone classifier, rake classifier, bowl classifier. Centrifugal separation-continuous centrifuges, super centrifuges, design of basket centrifuges; industrial dust removing equipment, cyclones and hydro cyclones, electrostatic and magnetic separators, heavy media separations, floatation, jigging.

Unit III

Flow through packed bed: Fixed bed and Fluidized bed, Pneumatic conveying. Theory of filtration, Batch and continuous filters, Flow through filter cake and filter media, compressible and incompressible filter cakes, filtration equipments -selection, operation and design of filters and optimum cycle of operation, filter aids.

Unit IV

Agitation and mixing of liquids. Storage and Conveying of solids - Bunkers, silos, bins and hoppers. Transportation of solids in bulk: different types of conveyers and their performance characteristics.

C. Reading Lists:

Books:

1. *McCabe W. L., Jullian Smith C. and Peter Harriott, "Unit Operations of Chemical Engineering", 7th Edition, McGraw-Hill International Edition, 2005.*
2. *Coulson J.M., Richardson J.F, "Chemical Engineering", Vol. II, 4th Edition, Elsevier India, 2006.*
3. *Badger W. L. and Banchero J.T., "Introduction to Chemical Engineering", Tata McGraw Hill, 1997.*
4. *Foust, A. S., Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., "Principles of Unit Operations", 2nd Edn., John Wiley & Sons, 1994.*

Journals:

1. *Chemical Engineering Science, Science Direct*
2. *Advances in Chemical Engineering – Science Direct*

Magazines:

1. *Chemical Engineering World Magazine*
2. *Chemical Engineering Magazine*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Name of the Module: Heat Transfer
Module Code: CHE - 403
Semester: 4th
Credit Value: 4 [P = 0, T =1, L = 3]

A. Objectives:
This course is designed to introduce the phenomena of heat transfer, mechanism of heat transfer, to develop methodologies for solving a wide variety of practical engineering problems, and to provide useful information concerning the performance and design of heat exchange equipment.

B. Subject Matter:
Unit I
Importance of heat transfer in process industries, modes of heat transfer - Conduction: Fourier's law, insulation, critical radius, extended surface of uniform thickness, steady state heat transfer through composite slabs, composite cylinders and unsteady state heat transfer-use of Gurney-Lurie chart.

Unit II
Convection: Individual & overall heat transfer coefficient, forced convection inside tubes and ducts - Reynold's analogy, Colburn analogy, Natural convection, condensation of single and mixed vapors, heat transfer to boiling liquids.

Unit III
Radiation: Concept of black body and laws of black body radiation, Kirchhoff's law, emissivity, radiant heat transfer between surfaces separated by non-absorbing media, radiation error in Pyrometry.

Unit IV
Heat exchange equipment: Shell-and-tube heat exchangers, Double-pipe heat exchanger, Condenser and Reboiler, heat transfer in agitated vessels. NTU and Effectiveness factor. Transient heat conduction in solid: Lumped capacitance model, Definition of Biot number and validity of lumped capacitance model.

C. Reading List:
  Books:
 1. *"Heat Transfer", Chapman A. J., Mac millan , New York, 2nd Ed. 1967*
 2. *"Heat Transfer", by Holman J. P., McGraw Hill, New York, 8th Ed 1997.*
 3. *"Process Heat Transfer", by Kern D. Q., Tata Mc Graw Hill Edition, 1997.*
 4. *"Fundamentals of Heat and Mass Transfer", by Dewitt et al.,John Willey & Sons,4th Ed. 1998.*
 5. *"Fundamentals of Momentum, Heat and Mass Transfer", Welty J.R., Wilson R.E., and Wicks C.E., John Wiley & Sons, Inc. New York, 4th Ed., 2000.*
 6. *"Heat Transfer", by R .C. Sachdeva.*

Journals:
 1. *International Communications in Heat and Mass Transfer, Science direct*
 2. *Chemical Engineering Communications - Taylor & Francis*

Magazines:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

1. *Chemical Engineering World (CEW)*
2. *Chemical Process Safety*

Name of the Module: Stochastic Process
Module Code: MAS - 401
Semester: 4th
Credit Value: 4[P = 0, T = 1, L = 3]

A. Objectives:
>   The course is design to meet with the objectives of:
>   1. Imparting theoretical knowledge and practical application to the students in the area of Stochastic Process.
>   2. Introducing the basic notions of probability theory and develops them to the stage where one can begin to use probabilistic ideas in statistical inference and modeling, and the study of stochastic processes.
>   3. Providing confidence to students in manipulating and drawing conclusions from data and provide them with a critical framework for evaluating study designs and results.
>   4. Injecting future scope and the research directions in the field of stochastic process.

B. Learning Outcomes:
`   Upon Completion of the subjects:
>   1. Students will add new interactive activities to fill gaps that we have identified by analyzing student log data and by gathering input from other college professors on where students typically have difficulties.
>   2. Students will add new simulation-style activities to the course in Inference and Probability.
>   3. Students will be substantially prepared to take up prospective research assignments.

C. Subject Matter:
Unit I

>   **Probability:Theory of Probability:** Random Experiment, Sample space; Random Events; Probability of events. Axiomatic definition of probability; Frequency Definition of probability; Finite sample spaces and equiprobable measure as special cases; Probability of Non-disjoint events (Theorems). Counting techniques applied to probability problems; Conditional probability; General Multiplication Theorem; Independent events; Bayes' theorem and related problems.
>   **Random variables** (discrete and continuous); Probability mass function; Probability density function and distribution function. Distributions: Binomial, Poisson, Uniform, Exponential, Normal, t and $\chi 2$. Expectation and Variance (t and $\chi 2$ excluded); Moment generating function; Reproductive Property of Binomal; Poisson and Normal Distribution (proof not required). Transformation of random variables (One variable); Chebychev inequality (statement) and problems.

Unit II

>   **Approximation Theory:** Binomial approximation to Poisson distribution and Binomial approximation to Normal distribution (statement only); Central Limit Theorem (statement); Law of large numbers (Weak law); Simple applications.

Unit III

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Sampling Theory: Population; Sample; Statistic; Estimation of parameters (consistent and unbiased); Sampling distribution of sample mean and sample variance (proof not required).

Estimation Theory: Point estimate, Maximum likelihood estimate of statistical parameters (Binomial, Poisson and Normal distribution). Interval estimation.

Testing of Hypothesis: Simple and Composite hypothesis; Critical Region; Level of Significance; Type I and Type II Errors; Best Critical Region; Neyman-Pearson Theorem (proof not required); Application to Normal Population; Likelihood Ratio Test (proof not required); Comparison of Binomial Populations; Normal Populations; Testing of Equality of Means; $\chi2$—Test of Goodness of Fit (application only).

Unit IV

Correlation and Regression: Simple idea of Bivariate distribution; Correlation and Regression; and simple problems

D. Teaching/Learning/Practice Pattern:

Teaching : 70%
Learning : 30%
Practice : 0%

(Teacher is to divide components for T/R/P)

E. Examination Pattern:

Theoretical Examination & Open book examination.

F. Reading list:

Books:

1. *P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory, Universal Book Stall", 2000.*
2. *Khazanie, Ramakant., "Basic Probability Theory and Applications", Santa Monica, CA: Goodyear, 1976.*
3. *Ross, Sheldon M.,"Introduction to Probability Models", New York, NY: Academic Press, 1972, 1985. Third Edition.*
4. *S. Ross, "A First Course in Probability", 6th Ed., Pearson Education India, 2002.*
5. *Cramer, Harald, "Random Variables and Probability Distributions", New York, NY: Cambridge University Press, 1970. Third Edition.*
6. *Parzen, Emanuel. "Modern Probability Theory and Its Applications", New York, NY: John Wiley, 1960.*
7. *Rothschild, V. and Logothetis, N. "Probability Distributions", New York, NY: John Wiley, 1986.*
8. *Bailey, Norman T.J. "The Elements of Stochastic Processes with Applications to the Natural Sciences", New York, NY: John Wiley, 1990.*
9. *Bhat, U. Narayan. ,"Elements of Applied Stochastic Processes", New York, NY: John Wiley, 1984. Second Edition.*
10. *Karlin, Samuel and Taylor, Howard M. "A First Course in Stochastic Processes", New York, NY: Academic Press, 1975. Second Edition.*
11. *Karlin, Samuel and Taylor, Howard M,. "A Second Course in Stochastic Processes", New York, NY: Academic Press, 1981.*
12. *J. Medhi, "Stochastic Processes", 3rd Ed., New Age International, 2009.*
13. *Ross, Sheldon M, "Stochastic Processes" New York, NY: John Wiley, 1983.*
14. *N.G. Das, "Statistical Methods", Vol-I & Vol-II, Mc Graw Hill.*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

15. *Murray R. Spiegel, "Probability and Statistics", McGrawHll, Schaum's Outline Series.*

Magazines:
1. *Current Science (Indian Academy of Science)*
2. *The Mathematics Student (Math Student) (Indian Mathematical Society)*
3. *Mathematical Spectrum(The University of Sheffield)*
4. *Mathematics Magazine (Mathematical Association of America)*
5. *+Plus magazine (University of Cambridge)*
6. *Ganithavahini (Ramanujan Mathematical Society)*

Journals:
1. *Advances in Probability and Related Topics (Marcel Dekker)*
2. *Annals of Applied Probability (Institute of Mathematical Statistics)*
3. *Annals of Probability (Institute of Mathematical Statistics)*
4. *Communications on Stochastic Analysis*
5. *Electronic Journal of Probability*
6. *Séminaire de Probabilités (Lecture Notes in Mathematics, Springer-Verlag)*
7. *Stochastic Modelling and Applied Probability (Springer-Verlag)*
8. *Stochastic Processes and their Applications*
9. *Stochastics: An International Journal of Probability and Stochastic Processes (Taylor & Francis)*
10. *Theory of Probability and its Applications (SIAM)*

11. *Stochastic Processes and their Applications, Elsevier.*

12. *Stochastics: An International Journal of Probability and Stochastic Processes,   Taylor*

    Francis Online.

13. *International Journal of Stochastic Analysis, Hindwai Publishing Corporation.*
14. *Journal of the American Statistical Association.*
15. *Journal of the Royal Statistical Society, Series A, Statistics in Society.*
16. *Journal of the Royal Statistical Society, Series B, Statistical Methodology.*
17. *Journal of the Royal Statistical Society, Series C, Applied Statistics.*
18. *SANKHA, ISI, Kolkata.*

Name of the Module: Process Control
Module Code: CHE - 404
Semester: 4th
Credit Value: 4 [P=0, T=1, L=3]

A. Subject Matter
Unit I

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Introduction to dynamics of processes. SISO, MIMO and MISO processes – examples. Properties of Linear systems. Laplace Transforms for dynamic characterization of processes – concept of Transfer function. Properties of transfer functions. Forcing functions. Characterization of First order (Interacting and non-interacting) and Second order systems. Dynamic Responses of First Order, Second Order and Pure Integrator systems to some standard inputs/ forcing functions.

Unit II

Nonlinearities in chemical process models: Examples – linearization. Responses of linearized systems and comparison to actual nonlinear responses by numerical simulation. Systems with dead time – non-polynomial transfer functions and use of Pade approximation for polynomial approximations to such transfer functions. First-order plus dead time (FOPDT) systems. Transfer functions of processes with numerator dynamics.

Unit III

Concept of feedback control of linear systems – control systems and their constituent elements, block diagram based representation, open-loop and closed-loop dynamics of controlled processes; effect of recycle on dynamics of chemical processes – examples. Controllers –P, PD, PI and PID controllers – their dynamic characteristics and effects on the dynamics of controlled processes.

Unit IV

Stability of dynamic systems - Routh-Hurwitz criteria; Root Locus method. Selection and Tuning of Controllers - Methods based on FOPDT model and Process Reaction Curve (PRC); Integral Error Criteria; Direct Substitution Method; Model-independent methods based on field trials - Continuous Cycling and Frequency Response. Bode Stability Criterion. Nyquist Stability Criterion; Ziegler-Nichols and Cohen-Coon optimum controller settings. Advanced Control Strategies (Preliminary treatment only), Ratio Control, Feed forward control, Cascade control, Selective Override control, Adaptive control. Computer Based Control.

B. Reading Lists:
  Books:
1. *"Process Dynamics and Control"by Del E Seborg, Thomas F. Edgar and Duncan A.*
2. *"Mellichammp Chemical Process Control: An Introduction to Theory and Practice", by George Stephanopoulos*
3. *"Process Dynamics and Control" by Coughnower and Koppel*
4. *"Process Dynamics and Control" by Coughnower*
5. *"Designing Processes and Control Systems for Dynamic Performance", by Thomas E Marlin.*
6. *"Process Control Systems", by F.G.Shinskey*
7. *"Applications Concepts of Process Control", by Murrill*
8. *"Fundamentals of Process Control", by Murrill*
9. *"Process Control: Modeling, Design and Simulation", by B.Wayne Bequette*

Journals:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Magazines:

Name of the Module: Fuel and Combustion
Module Code: CHE - 405
Semester: 4th
Credit Value: 3 [P = 0, T = 0, L = 3]

A. Subject Matter

Unit – I

Proximate & ultimate analysis of fuel, gross calorific value, net calorific value, ignition point, flash point, fire point,basis of repeating of analysis, orsat analysis. Biomass, peat, lignite, coal (semi-bituminous , bituminous, semi-anthracite, anthracite, cannel coal, boghead coal, natural coke, origin of coal, composition of coal, analysis of property of coal actions of heat on coal, oxidation of coal, hydrogenation of coal, classification of coal. Coal preparation, Storage of coal, coal carbonization, briquetting of solid fuels, gasification of solid fuels. Liquefaction of solid fuels: FT process, Lurgi process, etc.

Unit – II

Petroleum, origin of petroleum, petroleum product, composition of petroleum, classification of petroleum, nature of Indian crudes, petroleum processing, properties of testing of petroleum & petroleum products. Liquid fuels from sources other than petroleum, gasification of liquid fuels, storage & handling of liquid fuels.

Unit – III

Types of gaseous fuel, natural gas, producer gas, water gas, carbureted water gas, gasification of coal, coal gas, blast furnace gas, Coal Bed methane (CBM), gases from biomass, refinery gases, LPG. Oil gasification. Cleaning, purification & handling of gaseous fuels.

Unit – IV

Combustion stoichiometry, combustion thermodynamics, types of combustion process, mechanism of combustion reactions, spontaneous ignition temperature, velocity of flame propagation, limit of flame propagation, structure of flame, flame stability, Kinetics of solid & liquid fuel combustion. Gas burner, oil burner, coal burning equipment.

D. Reading Lists:
   Books:
1. *Fuels and Combustion* by Samir Sarkar
2. *Fuels and Combustion* by S. P. Sharma and C. Mohan
3. *Fuels and Fuel technology* by W. Francis
4. *Elements of Fuels, Furnaces and Refractories* by O. P. Gupta

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Journals:

Magazines:

Name of the Module: Numerical methods Laboratory
Module Code: CHE - 406
Semester: 4th
Credit Value: 3 [P = 3, T = 0, L =0]
  A. **Subject Matter:**

1. Solve the system of equations Ax = b using Gauss elimination method (3x3 matrix or 4x4 matrix).
2. Solve the system of equations Ax = b in tridiagonal form using Thomas Algorithm.
3. Solve the system of equations Ax = b using Jacobi Iteration method
4. Solve the system of equations Ax = b using Gauss Siedel method.
5. Write a program to find the largest (or smallest) Eigen value and corresponding eigen vector of a square matrix using power (or inverse power) method.
6. Find the root of an equation f (x) = 0 using Bisection method, Regular Falsi and Newton Raphson method.
7. Find the integral of a function using Trapezoidal rule, Simpson's 1/3rd and 3/8th rule.
8. Solve ordinary differential equations (initial value problem) using the different methods (single and multi-variable).
9. Write a program to solve second order ordinary differential equations (boundary value problem) using shooting method.

Name of the Module: Fluid Mechanics Laboratory
Module Code: CHE - 407
Semester: 4th
Credit Value: 3[P = 3, T = 0, L =0]

A. Objectives: Students will be having hand on experience carrying out the practical works on the subject.

B. Subject Matter:

1. Determination of co efficient of Discharge for Orifice meter
2. Experiments on Reynolds Apparatus for determination of flow regime and construction of Fanning friction factor vs. Reynolds No. plot.
3. Determination of co-efficient of Pitot tube and construction of velocity profile across the cross section of pipe.
4. Determination of co efficient of Discharge for Venturi meter

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

5. Experiment on fluidization techniques and determination of
   (a) Minimum fluidization velocity;
   (b) Pressure drop profile
6. Determination of pressure drop for flow through packed bed and verification of
   Ergun equation.
7. Determination of co-efficient of Discharge for different types of weirs.
8. Calibration of a Rotameter

SEMESTER V

Subject code	Subject	P	T	L	Credit
CHE - 501	Mass Transfer – I	0	1	3	4
CHE - 502	Chemical Reaction Engineering – I	0	1	3	4
CHE - 503	Process Instrumentation	0	0	3	3
CHE - 504	Chemical Process Calculations	0	1	3	4
CHE - 505	Chemical Process Technology – II	0	0	3	3
CHE - 506	Heat Transfer Laboratory	3	0	0	3
CHE - 507	Mechanical Operation Laboratory	3	0	0	3
CHE - 508	Fuel Technology Laboratory	3	0	0	3
		9	**3**	**15**	**27**

Name of the Module: Mass Transfer - I
Module Code: CHE - 501
Semester: 5th
Credit Value: 4 [P=0, T=1, L=3]

A. Objectives:

To provide introduction to physical and thermodynamic principles of mass transfer with an emphasis on how these principles affect the design of equipment and result in specific requirements for quality and capacity.

B. Subject Matter:

Unit I:

Molecular diffusion: Diffusivity, flux J and N, steady state diffusion in fluid at rest and laminar flow, molecular diffusion in gases in non-diffusing and equimolal counter diffusion, Pseudo steady state diffusion through a stagnant gas film, steady state diffusion in multicomponent mixtures, molecular diffusion in liquid, diffusivity of gases and liquids, diffusion through varying cross- sectional area Diffusion in solids-through polymers, porous solids, unsteady state diffusion in slabs, cylinders and spheres, transient mass transfer in semi infinite medium

Unit II:

Mass transfer coefficient in different units, mass transfer from a gas into a falling liquid film, eddy diffusion, Prandtl mixing length; Film theory: Lewis, Penetration and Surface Renewal theory; dimensionless numbers Flow past solids, Inter-phase mass transfer, Combination of

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

resistances, overall coefficient, correction applied to individual coefficient, heat, mass and momenteum transfer analogies, j_H and j_D factor

Unit III:

Gas Absorption: Co-current and counter-current absorption and desorption. Plate column – number of plates by graphical and analytical methods. Plate efficiency. Packed towers - pressure drop and flooding. Design of packed towers, Height of Transfer Unit, concept of H_{tG}, H_{tL}, H_tO_G and H_tO_L. Mass transfer coefficient in packed beds.

Unit IV:

Humidification and Dehumidification: Psychrometric chart, wet bulb and adiabatic saturation temperature, Air-water system, Design of cooling towers and dehumidifiers. Different types of cooling towers - their accessories & operational features.

Drying: Definition, Common terminologies. Drying rate curve, Constant and Falling rate periods, Mechanism of batch and continuous drying. Selection of dryers. Operation of batch and continuous dryers.

C. Reading Lists:
Books:
1. *R.E. Treybal, "Mass Transfer Operations", Mc Graw Hill.*
2. *C.J. Geankoplis, "Transport Processes and Unit Operations", 3rd ed. Prentice Hall.*
3. *A. S. Foust et.al., "Principles of Unit Operations" John Wiley (1980)*

Journals:
1. *International Journal of Heat and Mass Transfer, Elsevier.*
2. *Heat and Mass Transfer, Springer link.*

Magazines:
1. *Electronics Cooling, Mass Transfer Magazine*
2. *Igloo Mass Transfer Magazine*

Name of the Module: Chemical Reaction Engineering - I
Module Code: CHE - 502
Semester: 5th
Credit Value: 4 [P=0, T=1, L=3]

A. Subject Matter
Unit I

Kinetics of homogeneous reactions (*elementary and non-elementary*); autocatalytic Reactions; reversible reactions; interpretation of kinetic data; temperature and reaction rate.

Unit II

Design of Batch, CSTR and PFR; constant and variable volume reactions, Ideal reactors for a single reaction, multiple reactor systems including reactor staging. Semi-Batch Reactors,

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Recycle reactors; Multiple Reactions: design for irreversible series-parallel reactions; choice of reactors.

Unit III

Non-isothermal reactors: temperature and pressure effects on single and multiple reactions, design considerations; adiabatic reactors: operating line and design considerations. Reversible reactions in non-isothermal reactors; design considerations for exothermic and endothermic reactions; optimum temperature progression in various types of reactors; Reversible exothermic reaction with inter-stage and cold-shot cooling.

Unit IV

Non-ideal reactors: Basics of non-ideal flow; contacting pattern; residence time distribution; introduction to nonideal reactor models; calculation of conversion in non-ideal reactors.

B. Reading List
Books:
1. *"Chemical Reaction Engineering"* by Octave Levenspiel (3 Edition)
2. *"Elements of Chemical Reaction Engineering"* by H. Scott Fogler (4rd Edition)
3. *"Chemical Engineering Kinetics",* by J. M. Smith (3 Edition)

Journals:

Magazines:

Name of the Module: Process Instrumentation
Module Code: CHE - 503
Semester: 5th
Credit Value: 3 [P=0, T=0, L=3]

A. Subject Matter

Unit I

Introduction. Hardware for instrumentation. Need for measurement of Process variables. Functional elements in instrument. Classification of measurement errors (Deterministic and Probabilistic). Steady state and Dynamic characteristics of instruments. Instrument calibration technique, Selection of instruments. Process Instrumentation Diagram.

Unit II

Temperature Measurement. Different laws related to temperature measurement. Mechanical and Electrical sensors – constructions and operations.

Unit III

Pressure measurement- Manometers, Elastic deformation type Gauges. Strain gauge, Electrical transducers, High vacuum and differential pressure measurement. Flow

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

measurement- Variable head and area flow meters, Anemometers, Open channel flow - Weirs, Special flow measurement devices, Granular solid flow measurement.

Unit IV

Level measurement - Direct and Inferential type instruments, Granular solid level measurement. Density, Viscosity and Humidity measurement. Instrumentation Devices and Systems. Control valve: types and characteristics.

B. Reading List
Books:
1. *"Industrial instrumentation",* by Donald P. Eckman
2. *"Principles of Industrial Instrumentation",* by D. Patranabis
3. *"Instrumentation – Devices and Systems",* by C. S. Rangan
4. *"Handbook of Instrumentation",* by B.G.Liptak

Journals:

Magazines:

Name of the Module: Chemical Process Calculations
Module Code: CHE - 504
Semester: 5ᵗʰ
Credit Value: 4 [P = 0, T = 1, L = 3]

A. Objectives:

After completion this course the students will understand composition of mixtures, basic principles of stoichiometry, formulations of material balance equations with and without reactions, and of energy balance equation and their applications.

B. Subject Matter:
Unit I:

Units and dimensions, temperature, concept of mole. Composition of mixture, basis of calculations. Fuels: types of fuel, flue gas, orsat analysis, theoretical air, excess air. Partial saturation and humidity, types of humidity. Predicting P-V-T properties of gases using ideal gas equation, composition of gases based on mole, mass, volume and partial pressure, calculation of density. Solutions and their concentrations.

Unit II:

Basic concepts involved in material balance calculations, material balance problems without chemical reactions: mixing, drying, crystallization, membrane separation, distillation and extraction. Material balances involved in two-phase gas-liquid systems as in humidification and dehumidification. Basic concepts of recycle,

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

Syllabus for B-Tech (chemical engineering)

bypass and purge streams. Material balances for non reactive systems with recycle stream.

Unit III:

Chemical equation and stoichiometry, limiting reactant, excess reactant, conversion, selectivity, yield. Material balances for processes with reactions. Combustion as special case of material balance with reactions. Analysis of products of combustion, calculation of excess air.

Unit IV:

Heat capacity, empirical equations for heat capacities, mean heat capacities of gases, Kopp's rule, sensible heat and latent heats, calculation of enthalpy. Heat of formation, standard heat of combustion, law of Hess, calculation of the standard heat of reaction from heats of formation or combustion Enthalpy changes in reactions with different temperatures, calculation of theoretical flame temperature.

D. Reading Lists:
  Books:
 1. *David. M, Himmelblau, James. B .Riggs "Basic Principles and Calculations in Chemical Engineering", 7th Edn., Prentice-Hall of India, New Delhi, 2004.*
 2. *Richard. M, Felder, Ronald W. Rousseau, "Elementary Principles of Chemical Processes", 3rd Edition by John Wiley & Sons, Inc. Singapore, 2000.*
 3. *Bhatt. B. I. and Thakore.. S. B "Stoichiometry", 5th Edn., Tata McGraw-Hill Publishing Company, New Delhi, 2010.*
 4. *Hougen, Watson & Ragatz*

Journals:

 1. *Chemical Engineering and Processing: Process Intensification, Sciencedirect*
 2. *Journal of Engineering Research and Studies*

Magazines:

 1. *Chemical Engineering World (CEW)*
 2. *Chemical Process Safety*

Name of the Module: Chemical Process Technology - II
Module Code: CHE - 505
Semester: 5th
Credit Value: 3 [P=0, T=1, L=3]

A. Objectives:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

The objective of this course is to acquire basic understanding of chemical processes, complete knowledge of mechanism for commonly used reactions and their applications in different manufacturing processes.

B. Subject Matter:

Unit I:

Discussion on various unit processes like nitration, sulphonation, halogenations, oxidation, reduction, amination, esterification, etc. with industrial applications.

Unit II:

Important oil seeds, Extraction process, Physical and chemical refining of vegetable oil and by products, Hydrogenation of vegetable oils. Soaps and Detergents. Classification of cleansing compounds. Kettle and Twithcell process of soap manufacture, Glycerol recovery. Manufacture of detergents: Sulphated fatty alcohols and alkyl–aryl sulphonates, Biodegradable detergent.

Unit III:

Fermentation: Important features of Indian sugar industry, Major unit operations in sugar industry. Production of anhydrous or absolute alcohol and lactic acid using fermentation, Pollution problems. Manufacture of Paper: Raw materials, Pulping, Bleaching, etc. Fermentation of Biomass and derived chemicals.

Unit IV:

Manufacture of basic petrochemicals and downstream industries. Mechanism and methods of polymerization. Manufacture of Phenol formaldehyde, polyethylene, polystyrene and PVC. Engineering Plastics. Manufacture of nylon 6,6 and nylon 6 fibres, viscose rayon and polyester fibres. Rubbers - classification and processing.

C.Reading lists:
Books:
1. *Dryden's Outlines of Chemical Technology,* Edited by M. Gopala Rao, M. Sittig, Affiliated East-West Press Ltd
2. *G.T. Austin, Shreve's Chemical Process Industries,* Mc Graw Hill.

Journals:
1. *Journal of Chemical Engineering & Process Technology, Omics International.*
2. *Chemical Engineering and Technology, Willey-VCH*

Magazines:
1. *Process Worldwide Magazine*
2. *Chemical Processing Magazine*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Name of the Module: Heat Transfer Laboratory
Module Code: CHE - 506
Semester: 5th
Credit Value: 3 [P=3, T=0, L=0]

A. List of Experiments:
1. Determination of thermal conductivity of a metal bar using Fourier's equation.
2. Determination of heat transfer coefficient of air in forced convection and to study the effect of velocities on heat transfer coefficient.
3. Calculation of heat loss through a lagged pipe and determination of thermal conductivity of a given insulating material.
4. Determination of thermal conductivity of insulating powder in a spherical vessel.
5. Determination of over all heat transfer coefficient and efficiency of a Shell and Tube heat exchanger
6. Determination of over all heat transfer coefficient in a Counter current & Parallel flow double pipe heat exchanger.
7. Determination of Stefan's Boltzman constant using from temperature vs. time plot.
8. Determination of emissivity of an unknown surface for a given apparatus.

Name of the Module: Mechanical Operation Laboratory
Module Code: CHE - 507
Semester: 5th
Credit Value: 3 [P=3, T=0, L=0]

A. List of Experiments:
1. Determination of average particle size of a mixture of particles by sieve analysis.
2. Study and operation of Jaw crusher and thereby verification of Ritinger's constant.
3. Determination of reduction ratio, maximum feed size and theoretical capacity of crushing rolls.
4. Determination of the effect of no. of balls on grinding in a Ball mill and comparison of its critical speed with the operating speed.
5. To find out the effect of time on grinding and amount of undersize at zero time of grinding in a ball mill and to compare its operating speed with the critical speed.
6. To find out enrichment of the coal sample using a froth flotation cell.
7. Determination of the effectiveness of a vibrating screen.
8. To find the efficiency of Wilfley Table and the effect of water flow rate on efficiency of separation.
9. Study and operation of a Hammer mill thereby finding its reduction ratio.
10. Study on flow through packed bed and find out the pressure drop across the bed.

Name of the Module: Fuel Technology Laboratory
Module Code: CHE - 508
Semester: 5th
Credit Value: 3 [P=3, T=0, L=0]

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
Syllabus for B-Tech (chemical engineering)

A. List of Experiments:

1. Proximate analysis of coal to determine its composition.
2. Determination of Flash point & Fire point, Carbon residue, Viscosity & Viscosity Index of liquid fuels.
3. Determination of Hard groove grindability index of coal.
4. Estimation of Calorific values of solid, liquid & gaseous fuels (Junkers and Bomb Colorimeters may be used).
5. Orsat analysis of coal gas to determine its composition.
6. Determine the wash ability of coal
7. Determination of Caking Index and Swelling Index of coal.
8. Studies on flame stability and burner characteristics.
9. Studies on properties of bio-mass.

SEMESTER – VI

Subject code	Subject	P	T	L	Credit
CHE - 601	Mass Transfer - II	0	1	3	4
CHE - 602	Chemical Reaction Engineering- II	0	1	3	4
HSS - 601	Engineering Ethics & IPR	0	0	3	3
CHE - 603	Process Equipment Design - I	2	0	3	4
CHE - 606X	Elective - I	0	0	3	3
CHE - 607X	Elective - II	0	0	3	3
CHE - 604	Instrumentation & Control Lab.	3	0	0	3
CHE - 605	Reaction Engineering Lab.	3	0	0	3
		8	2	18	27

Name of the Module: Mass Transfer - II
Module Code: CHE - 601
Semester: 6th
Credit Value: 4 [P=0, T=1, L=3]

A. Objectives:

The course designed to meet with the objectives of the general objectives of Mass Transfer Operations-I are to discuss the fundamental concepts of mass transfer principles and to apply those concepts to real engineering problems. Each topic will be covered in logical sequence with relevant examples.

B. Subject Matter:

Unit I:

Vapour liquid equilibria; Raoult's law; Relative volatility; minimum and maximum boiling mixtures; enthalpy concentration diagrams for binary systems; Flash, Differential and Steam Distillation; Azeotropic and Extractive Distillation; Multistage tray towers; Graphical methods using McCabe-Thiele and Ponchon – Savarit analysis; minimum reflux, total reflux and optimum reflux ratio, open steam, multiple feed and side stream. Stage Efficiency. Multi component Calculations using Short-cut methods.

Unit II:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Liquid-liquid extraction – Phase equilibria. ternary diagram. selection of solvent. Co-current , counter current and cross-current operations. Single stage and multistage extraction, continuous counter current multistage extraction – estimation of number of plates. Batch and continuous extractors – fabrications and operations.

Unit III:

Solid-liquid Extraction- choice of solvent, Method of operation, Shank's system and other systems, equilibrium curve, single stage and multistage single cross current leaching, multistage counter current leaching using rectangular and triangular method. Crystallization: Solution and Melt crystallizations. Mechanism and methods. Crystal growth theory. Crystallizers and Purifiers.

Unit IV:

Adsorption- Adsorbents. adsorption equilibria – break through curve. adsorption for dilute solutions. adsorption of gas. Adsorption isotherms. PSA & TSA. Adsorbers – design and operations.

C. Reading Lists:
Books:
1. "R.E. Treybal, Mass Transfer Operations", Mc Graw Hill.
2. "C.J. Geankoplis, Transport Processes and Unit Operations", 3rd ed. Prentice Hall.
3. "A. S. Foust et.al., Principles of Unit Operations", John Wiley (1980)

Journals:
1. *International Journal of Heat and Mass Transfer,* Elsevier.
2. *Heat and Mass Transfer, Springer link.*

Magazines:
1. *Electronics Cooling, Mass Transfer Magazine*
2. *Igloo Mass Transfer Magazine*

Name of the Module: Chemical Reaction Engineering - II
Module Code: CHE - 602
Semester: 6th
Credit Value: 4 [P=0, T=1, L=3]

A. Subject Matter:
Unit I

Non-catalytic Heterogeneous Reactions: Progressive Conversion model and unreacted core model; Determination of controlling step, Application to design.

Unit II

Catalysis and Catalytic Reactors: rate equations for surface kinetics; mass transfer between the bulk fluid phase and external catalyst surface in isothermal reactors; pore and film diffusion resistances; deactivation and regeneration of catalysts.
Porous catalyst particles: Deriving the global reaction rate expression; determination of rate

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

controlling step; effectiveness factor; Performance equation for catalytic reactors with porous catalysts; Heat effects in catalytic reactors; adiabatic packed bed catalytic reactors.

Unit III

Absorption combined with chemical reactions; mass transfer coefficients and kinetic constants; application of film, penetration and surface renewal theories; Hatta number and enhancement factor for first order reaction, tower reactor design. Multiplicity: Steady state multiplicity in CSTRs.

Unit IV

Biochemical reaction kinetics and bioreactors: Enzymatic Reaction: Michaelis-Menten Kinetics; Competitive and Non-competitive Inhibition. Microbial Reaction: Microbial growth kinetics (Monod); substrate and product limiting scenarios for Batch, plug and Mixed flow, optimum operation of bioreactors.

B. Reading Lists:
   Books:
1. *"Chemical Reaction Engineering"* by O. Levenspiel
2. *"Chemical Engineering Kinetics",* by J. M. Smith
3. *"Elements of Chemical Reaction Engineering"* by H. S. Fogler
4. *"Reaction Kinetics for Chemical Engineers",* by S. M. Walas
5. *"Chemical Reactor Analysis and Design",* by K. B. Bishop and G. F. Froment

Journals:

Magazines:

Name of the Module: Engineering Ethics & IPR
Module Code: HSS - 601
Semester: 6th
Credit Value: 3 [P=0, T=0, L=3]

A. Objectives:

The course is design to meet with the objectives of: Imparting theoretical lectures with case discussion, providing teaching with inclusive learning and making students aware about the importance of this subject in their future

B. Subject Matter:

Unit I

Engineering as a profession, historical and social context, Ethics in Engineering, Codes of Engineering Ethics, history and purpose, consequentialism and utilitarianism, Deontological approaches, duties, rights and respect for a person, responsibility, virtue Ethics, honesty, moral autonomy, obligations of Engineering profession and moral propriety.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
Syllabus for B-Tech (chemical engineering)

Unit II
Engineer's moral responsibility for safety and human right, risk assessment and communication, product liability, development ethics, engineers and employer relationship, whistle blowing and its moral justifications.

Unit III
Computer Ethics: Social impact of computers, Computer and gender issues, n privacy, cyber crime, ethical use of software's, intrinsic value of nature.

Unit IV
IPR I: Intellectual property, definition, types, rights and functions, patents, trademark, software design, industrial designs, semi-conductor and integrated circuits layout design, grant of patent in India, authority and procedure, patent forms, surrender and revocation of patents and compulsory licensing, acquision of inventions by the Government.

IPR II: Contents of draft application for patents, Drafting patent specification and claims, WTO and drafting patent specification and claims, IPR in fringement and piracy under Indian Laws.

C. Reading Lists:

Books:
  (i) Chowdhury, Subir, "Blending the Best of the East & West", Excel
  (ii) Ghosh, Vikas, "Ethics and Mgmt. & Indian Ethos",
  (iii) Pherwani, "Business Ethics", EPH
  (iv) Balachandran Raja,Nair, "Ethics, Indian Ethos and Mgmt", Shroff Publishers
  (v) Velasquez, "Business Ethics: Concept and Cases", Pearson

Journals:

  (i) Journal of Business Ethics
  (ii) The Journal of Ethics
  (iii)Ethics, University of Chicago Press
  (iv) Kennedy Institute of Ethics Journal
  (v) Journal of Global Ethics

Magazine:

  (i) Industry Week

Name of the Module: Process Equipment Design & Drawing - I
Module Code: CHE - 603
Semester: 6th
Credit Value: 4 [P=2, T=0, L=3]

A. Objectives:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

The objective of this course is to acquire basic understanding of design parameter, complete knowledge of design procedures for commonly used process equipment and their attachments, and different types of equipment testing methods.

B. Subject Matter:

Unit I:
    Detailed process design of heat exchanger.
Unit II:
    Detailed process design of Evaporator.
Unit III:
    Detailed process design of Agitated vessel.
Unit IV
    Fundamental principles, equations, general design of cyclone separators centrifuges, thickeners and filtration equipment.

C. List of Practicals:

1. Detailed design and drawing using AUTOCAD of Pressure vessel.
2. Detailed design and drawing using AUTOCAD of enclosures and supports.
3. Detailed design and drawing using AUTOCAD of agitated vessel.
3. Detailed design and drawing using AUTOCAD of basket centrifuge.
4. Detailed design and drawing using AUTOCAD of gravity thickener.
5. Detailed design and drawing using AUTOCAD of cyclone separator.

Name of the Module: Elective - I
Module Code: 606X
Semester: 6th
Credit Value: 3 [P=0, T=0, L=3]

Syllabi of the Electives will be given later on

Name of the Module: Elective - II
Module Code: 607X
Semester: 6th
Credit Value: 3 [P=0, T=0, L=3]

Syllabi of the Electives are given later on.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Name of the Module: Instrumentation & Control Lab
Module Code: CHE - 604
Semester: 6th
Credit Value: 3 [P=3, T=0, L=0]

A. List of Experiments:
1. Calibration of Bourdon gauge using dead –weight tester
2. Calibration of thermo couple
3. Estimation of time constant of a Hg- in –glass thermometer
4. Control of level of liquid in a tank using p/pd/pi/pid controller
5. Control flow rate of liquid/ gas flowing through a pipe using P/PD/PI/PID controller
6. Use of Pressure controller to determine the pressure in the flow conduit
7. Use of Temperature controller to determine the temperature in a process
8. Estimation of damping coefficient
9. Use of process simulators

Name of the Module: Reaction Engineering Lab
Module Code: CHE - 605
Semester: 6th
Credit Value: 3 [P=3, T=0, L=0]

List of Experiments:
1. To study the progress of a chemicals reaction and determine the kinetic parameters in a isothermal batch reactor.
2. Determine the effect of temperature on reaction rate constant in a batch reactor.
3. Study the decomposition of hydrogen peroxide with water in presence of an iodide catalyst and predict the degree of conversion from time-temperature data in an adiabatic batch reactor.
4. Study the progress of a chemical reaction in CSTR and determine the reaction rate constant.
5. Study the saponification reaction in Packed Bed Reactor and determine the reaction rate constant.
6. RTD study in a CSTR
7. RTD study in a Packed Bed Reactor

List of Electives I & II
Name of the Module: Petroleum Refining & Petrochemicals
Module Code: CHE - 606A
Semester: 6th
Credit Value: 3 [P=0, T=0, L=3]

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

A. Objectives:

The course is design to meet with the objectives of: to acquire a solid base in refining techniques, to select and design the main equipment of processing plants, to learn about the technology and operation of equipment and to understand the main refining processes, their fundamental aspects and operation.

B. Subject Matter:

Unit I:

Introduction – genesis, occurrence, exploration, drilling of crude oil. Composition and Evaluation of crude oil and testing of petroleum products, Petroleum exploration, enhanced oil recovery by water and steam injection technologies, Refining of petroleum – Atmospheric and vacuum distillation, Pretreatment of crude oil and transportation.

Unit II:

Cracking processes C Thermal cracking, Vis C breaking, Coking, Catalytic cracking (FCC), Hydro cracking, Rebuilding processes, bitumen blowing.

Unit III:

Treatment techniques for removal of sulphur compounds to improve performance, Storage and stability. Product treatment processes C various solvent treatment processes, Dewaxing ,Clay treatment and Hydro fining.

Unit IV:

Cracking of naphtha and gas for the production of ethylene, propylene isobutylene and butadiene. Production of acetylene from methane Catalytic Reforming of petroleum feed stocks, Extraction of Aromatics.

C. Reading Lists:

Books:

1. *B.K.Bhaskara Rao, "Modern Petroleum Refining Processes", 2nd Edn., Oxford and IBH Publishing Company, New Delhi, 1990.*
2. *W.L.Nelson," Petroleum Refinery Engineering", 4th Edn., McGraw Hill, New York, 1985.*
3. *Robert. A. Meyers, "Handbook of Petroleum Refining Processes", Mc Graw Hill, 1986.*
4. *G.D.Hobson and W.Phol, "Modern Petroleum Technology", Applied science Publishers, 4th edition, 1975.*

Journals:

1. *International Journal of Oil, Gas and Coal Technology, Inder science*
2. *Geo Journals, Springer Link*

Magazines:

1. *Hydrocarbon Processing*
2. *Petroleum Processing & Petrochemicals*
3. *Oil and Gas Magazine*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Name of the Module: Energy Engineering
Module Code: CHE - 606B
Semester: 6th
Credit Value: 3 [P=0, T=0, L=3]

A. Objectives:
The course is design to meet with the objectives of to provide knowledge and understanding to the students regarding source and applications of energy, to implement energy strategies and policies for leading manufacturers, innovative start-ups and public organizations and to prepare students for advanced energy research and development.

B. Subject Matter:
Unit I:
 Otto, Diesel, semi-diesel, and Brayton cycle. Representation of these on P-V and T-S diagrams. Calculations of work and power. Pumps and Compressors: Types, constructional details Vacuum Systems: Vacuum pumps, Ejectors: Types, constructional details

Unit II:
 Steam Engineering, Study of the properties of steam high and low pressure boilers. Steam power plants, and power calculations using steam tables and Moellier Chart, types of steam turbines, gas turbines, Co-generation of steam and electricity

Unit III:
 Refrigeration Cycles: types of refrigerants, refrigeration systems, Energy conservation strategies in the above systems

Unit IV:
 Transmissions: Types of drives, group and individual drives, their merits and demerits. Belts, chain and gear drives. Calculations of pulley sizes and gear trains for speed reduction.
 Study of bearings: (Journal, ball and roller bearings), stuffing box, keys and bolts, mechanical seals and their types, Bearing to withstand end thrust. Shafts and couplings.

C. Reading Lists:
 Books:
  1. *Thermodynamics, P. K. Nag*
  2. *Heat Engines, P. L. Ballany*
  3. *Heat Engines, Vasnandani*
  4. *Heat Engines, Wrangham*
 Journals:
  1. *Power Electronics, IEEE Transactions on*
  2. *Power Systems, IEEE Transactions on*
 Magazines:
  1. *Power and Energy Magazine, IEEE*
  2. *Power Electronics Magazine, IEEE*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Name of the Module: Pollution Control in Process Industries
Module Code: CHE - 606C
Semester: 6th
Credit Value: 3 [P = 0, T = 0, L = 3]

A. Objectives:
To analyze the effects of pollutants on the environment, understand meteorological aspects of air pollution, air pollution control methods.

B. Subject Matter:
   Unit I:
      Introduction: Biosphere, Hydrological cycle, Nutrient cycle, Consequences of population growth, Pollution of air, Water and soil. Air pollution sources & effects: Classification and properties of air pollutants, Emission sources, Behavior and fate of air pollutants, Effect of air pollution. Meteorological aspects of air pollutant dispersion: Temperature lapse rates and stability, Wind velocity and turbulence, Plume behavior, Dispersion of air pollutants, Estimation of plume rise.
   Unit II:
      Air pollution control methods & equipment: Control methods, Source correction methods, Cleaning of gaseous effluents, Particulate emission control, Selection of a particulate collector, Control of gaseous emissions, Design methods for control equipment.
   Unit III:
      Population growth, variation among nations–population explosion–family welfare programme–environment and human health–human rights–value education – HIV/AIDS–women and child welfare–Environmental impact analysis (EIA)-GIS-remote sensing-role of information technology in environment and human health–Case studies.
   Unit IV:
      Meteorological aspects of air pollutant dispersion: Temperature lapse rates and stability, Wind velocity and turbulence, Plume behavior, Dispersion of air pollutants, Estimation of plume rise.

C. Reading list:
   Books:
   1. Rao C.S*., "Environmental Pollution Control Engineering",* Wiley Eastern Limited, India, 1993.
   2. Noel de Nevers*, "Air Pollution and Control Engineering",* McGraw Hill, 2000.
   3. Glynn Henry J. and Gary W. Heinke*, "Environmental Science and Engineering",* 2nd edition, Prentice Hall of India, 2004.
   4. Rao M.N. and Rao H.V.N – *"Air Pollution",* Tata – McGraw Hill Publishing Ltd., 1993.
   5. De A.K – *"Environmental Chemistry",* Tata – McGraw Hill Publishing Ltd., 1999.

   Journals:
   1. *Nature Chemistry*
   2. *Journal of Progress in Energy and Combustion Science*
   3. *Annual Review of Chemical and Biomolecular Engineering*
   4. *Journal of Fuel Processing Technology*
   5. *Journal of Chemical Engineering Science*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

6. *Journal of Chemical Engineering and Processing*
7. *Journal of Industrial and Engineering Chemistry Research*
8. *International Communications in Heat and Mass transfer*

Name of the Module: Nuclear Energy
Module Code: CHE - 607A
Semester: 6th
Credit Value: 3 [P = 0, T = 0, L = 3]

A. Objective:
To understand radioactivity, nuclear fission and fusion, the interaction of alpha, beta and gamma particles with matter, engineering aspects of nuclear power production and environmental effects.

B. Subject Matter:
Unit I:
Nuclear Energy Fundamentals: Atomic structure and Radio isotopes, Nuclear fission and fusion, types and classification of nuclear reactors, nuclear fuels, other reactor materials, fuel processing flow sheet, chemical processes for nuclear power industries, separation of reactor products, nuclides

Unit II:
Nuclear Reactions and radiations: Radioactivity, interaction of alpha and beta particles with matter, decay chains, neutron reactions, fission process, growth and decay of fission products in a reactor with neutron burnout and continuous processing. Make up of reactor, reactor fuel process flow sheet, irradiation schemes, neutron balance, feed requirements and fuel burn up for completely mixed fuels with no recycle.

Unit III:
Nuclear Reactor theory: The neutron cycle, critical mass, neutron diffusion, the diffusion equation, slowing down of neutrons, reactor period, transient conditions and reflectors.

Unit IV:
Engineering Consideration of nuclear Power-Environmental effects: Introduction to nuclear power systems, Thermal-hydraulics: Thermal parameters: definitions and uses. Sources and distribution of thermal loads in nuclear power reactors. Conservation equations and their applications to nuclear power systems: power conversion cycles, containment analysis Thermal analysis of nuclear fuel, Single-phase flow and heat transfer, Two-phase flow and heat transfer.

C. Reading List:
  Books:
  1. Glasstone S and Alexender Seasonske*, "Nuclear Reactor Engineering",* 3rd Edition, CBS Publisher, USA, 1994.
  2. K. Sriram*, "Basic Nuclear Engineering",* Wiley Eastern Ltd., 1990.
  3. W Marshall*, "Nuclear Power Technology",* Vol I, II, and III, Oxford University Press, New York 1983.

Journals:
  1. *Nature Chemistry*
  2. *Journal of Progress in Energy and Combustion Science*
  3. *Annual Review of Chemical and Biomolecular Engineering*
  4. *Journal of Fuel Processing Technology*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

5. *Journal of Chemical Engineering Science*
6. *Journal of Chemical Engineering and Processing*
7. *Journal of Industrial and Engineering Chemistry Research*
8. *International Communications in Heat and Mass transfer*

Name of the Module: Pulp and Paper Technology
Module Code: CHE - 607B
Semester: 6th
Credit Value: 3 [P = 0, T = 0, L = 3]

A. Objectives:
Focused on papermaking science and technology and is intended to be especially valuable to students majoring in programs leading to careers in corporate or government positions which would interface with the paper related industries.

B. Subject Matter:
Unit I:
Introduction: History of Paper Making, Technological Advancements, Global and Indian Market Situation. Paper making raw materials: Wood anatomy and chemistry, Wood chip preparation and handling at the pulp mill, Solid wood measurement, Properties of selected wood species.

Unit II:
Pulping processes: Introduction to pulping, Mechanical pulping, Chemical pulping, Semi-chemical pulping, Soda pulping, Kraft pulping, Sulfite pulping, Other pulping methods. **Pulp treatment:** Bleaching mechanical pulps, Measurement of lignin content, Bleaching chemical pulps, Chemical recovery, Refining, Pulp characterization.

Unit III:
Paper making equipment and process: Fiber preparation and approach, Raw materials, Functional additives, Control additives, Wet end chemistry, Paper manufacture, Paper machine, headbox, fourdrinier wet end, Twin wire formers, cylinder machine, press section, dryer section, Post drying operations, Coating.

Unit IV:
Environmental protection: Water pollution, Water quality tests, Aqueous effluent treatments, Air pollution, Air quality tests and control, Solid waste disposal.
Properties of paper: General grades of paper, Structure, Mechanical and chemical properties, Basic optical tests of paper.

C. Reading Lists:
Books:
1. *J.P. Casey, Pulp and Paper, "Chemistry and Chemical Technology, 3rd Edition", Volumes 1 & 2., Wiley Interscience, 1980*
2. *G.A. Smook, "Handbook for Pulp and Paper Technologists, 3rd Edition", Angus Wilde Publ, Inc, 2002.*
3. *Christopher J. Biermann, "Handbook of Pulping and Paper Making", Academic Press, 1996.*

Journals:
1. *Nature Chemistry*
2. *Journal of Progress in Energy and Combustion Science*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

3. *Annual Review of Chemical and Biomolecular Engineering*
4. *Journal of Fuel Processing Technology*
5. *Journal of Chemical Engineering Science*
6. *Journal of Chemical Engineering and Processing*
7. *Journal of Industrial and Engineering Chemistry Research*
8. *International Communications in Heat and Mass transfer*

Name of the Module: Chemical Plant Safety and Occupational Hazard
Module Code: CHE - 607C
Semester: 6ᵗʰ
Credit Value: 3 [P = 0, T = 0, L = 3]

A. Objectives:
To familiarize basics of industrial safety management, various aspects of chemical plant safety, various aspects of industrial accidents and fire safety, Hazard identification techniques and industrial hygine and occupational health hazards, safety legislation in chemical industries.

B. Subject Matter:
Unit I:
Development of Industrial Health and Safety, Safety Organization –Polices-Culture -Planning-Promotion – Inspection –Rules- Responsibility – Supervision, Safety Committee – role of safety functionaries, Elements of work place Safety Program, Economic and Social Benefits from Safety Program- Effective Safety Education and Training – Communication at various levels of production and operation, Safety slogans Chemical process Industries - Sitting and Layout of a Chemical plant, Safety in transportation, storage and handling of hazardous chemicals, Chemical process hazards and their control - First degree and second degree hazards. Lines of defense - High pressure - High temperature operations – Case studies, Emergency preparation: On-site and Offsite , Safety aspects of maintenance in chemical plant - Effective steps to implement safety procedures-Periodic Advice and checking to follow safety procedures and rules- Safe guarding of Machines – Ergonomics -Proper selection and replacement of handling equipment –Safe handling and operation of materials and machineries

Unit II:
Definitions, H.W.Henrich, Frank bird & Multiple Causation theories of accident occurrences, Classification, Causes, Costs -Industrial accidents, Principles of Accident prevention, Accident prevention technique – Plant and Chemical job safety analysis, Accident proneness-vocational guidance, Safety performance measurement tools - FR. SR, (FSI), Safe-T-Score, Accident rate per 1000 workers, Disabling injury index, Accident Compensation Statutes, Accident Investigation reporting and Analysis - Case studies. Conditions -Fire triangle- Classification of fires, Common causes of industrial fires, Fire protection systems prevention- Case studies, Safety in Explosive

Unit III:
Safety Appraisal - Risk Assessment -Hazard identification techniques with examples such as FMEA, CMA, Fault Tree Analysis, Preliminary Hazard Analysis (PHA), Hazard and operability (HAZOP) study, Quantitative risk analysis-Out line of methodology, Consequences analysis (Calculation of release rates of liquids under ambient pressure and liquids under pressure, Calculation of dispersion of released gases and vapors and platting of equal concentration contours), Dow (Index) Fire and Explosion Index System of Risk Analysis, Safety Audit.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Unit IV:

Concepts - Industrial and Occupational health hazards, Housekeeping, human factors and error, stress at work, Personnel protective equipments, Role of trade unions in Industrial safety and health. Introduction to ILO, Safety legislation in India, Factories act 1948, Employees welfare and legislation , Provisions relating to safety , health & environment in other important legislations - Indian boilers act and regulations, Indian electricity act and rules, Indian explosives act and rules, Mines act, Petroleum act and rules. Environmental protection act.

C.Reading Lists:
  Books:
1. *Sarma. A M "Safety and Health in Industry" -A Hand book", BS Publications, 2009.*
2. *Fulekar. M.H, "Industrial Hygiene and Chemical Safety", I.K International Publishing house Pvt Ltd., 2006.*
3. *Fawcett .H.H, and Wood .W.S, "Safety and Accident Prevention in Chemical Operations", John Wiley & sons, U.S.A., 1965.*
4. *Willie Hammer &Dennis Price, "Occupational Safety Management and Engineering", Prentice Hall, 2001.*
5. *William Handley, "Industrial Safety Hand Book", McGraw- Hill, 1969.*
6. *Daniel. A, Crowl & Joseph. F Louvar, "Chemical Process Safety: Fundamentals with Applications", Prentice Hall international series.*

Journals:
1. *Nature Chemistry*
2. *Journal of Progress in Energy and Combustion Science*
3. *Annual Review of Chemical and Biomolecular Engineering*
4. *Journal of Fuel Processing Technology*
5. *Journal of Chemical Engineering Science*
6. *Journal of Chemical Engineering and Processing*
7. *Journal of Industrial and Engineering Chemistry Research*
8. *International Communications in Heat and Mass transfer*

Name of the Module: Power Plant Engineering

Module Code: CHE - 607D

Semester: 6th

Credit Value: 3 [L = 3, T = 0, P = 0]

A. Objectives:

The course is design to meet with the following objectives:

1. Analysis and preliminary design of the major systems of conventional fossil-fuel steam-cycle power plants.

2. A working knowledge of the basic design principles of nuclear, gas turbine, combined cycle, hydro, wind, geothermal, solar, and alternate power plants.

3. Awareness of the economic, environmental, and regulatory issues related to power generation.

B. Course Outcome:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

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

1. Understand the energy resources and energy conversion methods

2. Determine the efficiency and output of a Rankine cycle, Brayton cycle etc.

3. Calculate the performance of steam and gas turbines with reheat and regeneration, and discuss the performance of combined cycle power plants.

4. Analyse the design of the major components of a conventional or alternate power plant.

C. Course Matter:

Power Plant in General: Introduction to different power plants, Load duration curves, Location of power Plants, Power plant economics and Indian energy scenario.

Steam Power Plant: Introduction, Rankine cycle, Carnot cycle, Reheating of steam, Regeneration, Steam power plant appraisal, Deaeration, Typical layout of steam power plant, Efficiencies in steam Power plant, Co generation of power and process heat, combined cycle power generation, Different types of fuel used for steam Generation, Draught system, Classification of boilers, Boiler accessories, Classification of steam turbines and their working, fluidized bed.

Gas Turbine Power Plant: Introduction, Classification of different gas turbine power plants, Reheat and regeneration cycle, Analysis of closed cycle and open cycle constant pressure gas turbine plant, components of gas turbine plants.

Hydro-Electric Power Plant: Introduction, Classification of hydro-electric power plant, Site selection, Elements of hydro-electric power plant, Advantages of hydro-electric power plant, Classification of hydraulic turbines and its selection, Hydrographs, Flow duration curves.

Nuclear Power Plant: Introduction to nuclear engineering, Types of nuclear reactors, Pressurized water reactor, Boiling water reactor, CANDU reactor, Gas-cooled reactor, Liquid metal fast breeder reactor, India's nuclear power programme.

Non-Conventional Power plants: Prospect of renewable energy source, Types of non-conventional power plants, solar plants, Wind power plants, Bio-mass plants, Geo-thermal power plant, Tidal power plant, Fuel Cell, Thermoelectric generator

D. Books:

1. P. K. Nag, "Power Plant Engineering", TMGH.

2. S. C. Arora & S. Dom Kundwar, "A Course in Power Plant Engineering".

3. M. M. Elwakil, "Power Plant technology", MGH.

4. R. K. Rajput, "Power Plant Engineering", Laxmi

5. Black and Veatch, "Power Plant Engineering", MGH

6. F. T. Morse, "Power Plant Engineering".

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

SEMESTER VII

Subject code	Subject	P	T	L	Credit
CHE - 701	Creative Design	4	0	0	4
HSS - 401	Entrepreneurship & Innovation for Practices	0	0	3	3
HSS - 703	Industrial Economics	0	0	3	3
HSS - 501	Industrial Management	0	0	3	3
CHE - 702	Transport Phenomena	0	0	3	3
CHE - 703	Process Equipment Designs – II	1	0	3	4
CH.E - 704	Project Work	6	0	0	6
CHE - 705	Seminar	2	0	0	2
CHE - 706	Mass Transfer - II Lab	3	0	0	3
		16	0	15	31

Name of the Module: Creative Design
Module Code: CHE - 701
Semester: 7th
Credit Value: 4 [P = 4, T = 0, L = 0]

This course is building an innovative curriculum to prepare for students. It encourages students to reflect on their experience in the course and to attempt to express that experience in a tangible way. It provides an outlet for those students with a creative bent to express their individuality, hopefully dispelling the stereotype that engineers aren't creative. (Excellent ideas for integrating creativity exercises in courses throughout the curriculum).

Name of the Module: Entrepreneurship & Innovation for Practices
Module Code: HSS - 401
Semester: 7th
Credit Value: 3[P = 0, T = 0, L = 3]

A. Objectives:

B. Learning Outcomes:

Upon completion of the subject:

1. Students will be able to start their venture more scientifically.
2. Students will be able to start their venture by linking with the financial institutions.

C. Subject Matter:

Unit 1:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Introduction to Entrepreneurship: Meaning, Role of Entrepreneur, Entrepreneur Process: different approaches, Motivation for becoming an Entrepreneur. SME Concept, its role, status, prospects and policies for promotion of SMEs. Importance of Entrepreneurship: innovations, Qualities of successful Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneur, Issues & Problems Entrepreneurial Practices,

Unit II:

Importance of Entrepreneurship: innovations: Converting Innovation to Economic Value which includes, Growth Strategies, value position, Market Segments, Value Chain Structure, Revenue Model etc., Qualities of successful Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneur, Issues & Problems Entrepreneurial Practices. Contribution of Entrepreneurs: Towards R&D, creates Wealth of Nation & Self prospect with Challenge. Entrepreneur Carrier: Different Stages, Entrepreneur Development Programmers (EDPs).

Unit III:

Characteristics of Entrepreneurship: Risk taker, Perceptive, Curious, Imaginative, Persistent, Goal setting, and Hardworking, Research & Management Skill, Organising & Controlling, Soft skills and Feasibility. Women Entrepreneurship: Opportunities, promotion Hurdles and Prospects of women Entrepreneurs. Factors & Models of Entrepreneurial Development. Social Entrepreneurial Initiative: Solving social Problems, Business plan, Strategic Plan vs Business Plan

Unit IV:

Forest based Industries: Mobilization of resources from NTFP products, Processing units, Technical and Financial Feasibility study and analysis of projects under self employment scheme including small entrepreneur. Farm based enterprises for production and post production of Agri-produce: Crops: Cereals, Legumes, Oilseeds; Horticulture crops : Fruits and vegetables; Livestock production : Poultry, Fishery, Medicinal and Aromatic plants. Handlooms & Sericulture; Handicraft, coir, jute & leather Micro entrepreneurial skills development and good production practices

D. Teaching/ Learning/ Practice Pattern:

> Teaching: 70%
> Learning: 30%
> Practice: 0%

E. Examination Pattern:

> Theoretical Examination

F. Reading Lists:

Books:

1. "Management and Entrepreneurship" by N. V. R. Naidu, Naidu I. K. International Pvt Ltd, 01-Jan-2008
2. "Social Enterprise Developing Sustainable Businesses", by Frank Martin and Marcus Thompson Palgrave Macmillan
3. "Small Business Management and Entrepreneurship", by David R. Stokes, Nicholas Wilson Cengage Learning EMEA, 2006 - Business & Economics

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

4. *"Entrepreneurship: Theory, Process, Practice", by Donald F. Kuratko Cengage Learning, 14-Nov-2008 Business & Economics*
5. *"Essentials of Entrepreneurship and Small Business Management", by Thomas Zimmerer, Norman M. Scarborough, Doug Wilson Pearson/Prentice Hall, 2008 - Business & Economics*
6. *"Entrepreneurship 6/E", by Robert D. Hisrich Tata McGraw-Hill Education, 2011 Entrepreneurship*

Journals:

1. *International Journal of Entrepreneurship*
2. *International Journal of Innovation Management*
3. *Journal of Small business and Entrepreneurship*
4. *Journal of Human Values.*
5. *Journal of Management Research*

Name of the Module: Industrial Economics
Module Code: HSS - 703
Semester: 7th
Credit Value: 3 [P=0, T=0, L=3]

A. Objectives:

This course provides an introduction to current theory and empirical work in Industrial economics. It starts by examining the internal structure of firms. It then moves on to the analysis of various aspects of strategic interaction between firms and the determinants of industrial structure. Finally, it discusses the role of policy in the context of competition and industrial policies and regulation. The emphasis will be throughout on understanding how the theoretical tools can be used to analyse real world issues.

C. Subject Matter:

Unit I:

Definition and scope of engineering economics, Concept of supply and demand
Price elasticity and cross elasticity of demand Production, Engineering costs and cost estimation, Concept of time value of money, Cash flow analysis

Unit II:

Perfect competition, Monopoly, Monopolistic competition

Unit III:

National Income, GDP, Inflation, Deflation and treatment

Unit IV:

Functions of RBI, Indian Tax System

C. Reading Lists:

Books:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

1. Henderson, M. James and Quandt, E. Richards, "Microeconomic Theory: A Mathematical Approach".
2. Koutsoyiannis, A., "Modern micro economics".
3. Ardwick, Philip, Khan Bahadure, Langmeed, John, "An Introduction to Modern Economics".
4. Samuelson, A. Paul, "Economics".
5. Shapiro, Edward, "Macro economics".
6. Newnan, G. Donald, Eschenbach, G.Ted, Lavelle, P. Jerome, "Engineering Economic Analysis".

Journals:
  (i) International Journal of Industrial Organization, Elsevier.
  (ii) Journal of Industrial Economics, Blackwell Publishing

Magazines:
  (i) Business Magazines
  (ii) Customer Magazines

Name of the Module: Industrial Management
Module Code: HSS - 501
Semester: 7th
Credit Value: 3 [P=0, T=0, L=3]

A.Objectives:
The course is design to meet with the objectives of: Imparting theoretical lectures with case discussion, providing teaching with inclusive learning and making students aware about the importance of this subject in their future career.

B.Subject Matter:
Unit I
   Concept of Management: Various Approaches to Management, Management as – an art, a Science, and a Profession, Managerial skills, Process of management, Planning-Mission, Goals, Strategy, Program and Procedure; Decision making-process, decision making under risk and uncertainty, Models of decision making.
Unit II
   Principles of Organization: Organizational Structure, span of control, Staffing function with emphasis on, Performance Appraisal, Training and Development.

Unit III
   Direction and coordination: Motivation and Leadership, control function-Process and Techniques.
Unit IV
   Production Management: Types of Production, Locational Decisions, Plant layout and design, Production. Planning scheduling and control: work study, method Study, and

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Wage Payment Schemes and Bonus, Productivity – concept and measurement.
Material Management: Inventory Planning, Procurement-functions, procedures and control, storing-planning procedure and control, issue and pricing, Inventory control Techniques, Value analysis and Engineering.

C.Reading Lists:
  Books:
   1. *Badiru , A (ed),2005, "Hand Book of Industrial and System Engineers", CRC press.*
   2. *Blanchand, B & Fabrycky, W.2005, "System Engineering Analysis (4th Ed.)", Prentice Hall.*
   3. *Salvendy,G.(Ed.)2001, "Hand Book Of Industrial Engineering: Technology &Operations Management", Wiley-Inter service.*
   4. *Turner, W.et.al.1992 Introduction to Industrial and System Engineering(3rd ed.) Prentice Hall.*

 Journals:
   1. *Group and Organization Management*
   2. *Journal of Organizational Behavior*
   3. *Journal of Management.*

Magazines:
   (i) *Industrial Management Magazine*
   (ii) *Industrial Research Institute*

Name of the Module: Transport Phenomena
Module Code: CHE - 702
Semester: 7th
Credit Value: 3 [P = 0, T = 0, L = 3]

A. Objectives:
To provide the fundamentals for the application of basic laws of mass, momentum and energy transport in engineering analysis. Formulate mathematical representations of momentum/heat/mass transfer phenomena.

B. Subject Matter:
Unit I

Importance of heat, mass and momentum transfer in chemical engineering; Overview of transport mechanisms; Dimensional analysis.

Unit II

Shell momentum balance and its application: flow of falling film along an inclined plane; flow through circular tube, flow through annulus, Flow of two adjacent immiscible fluids. creeping flow around a sphere. Equation of continuity, equation of motion, Navier Stokes equation, Euler's equation for Cartesian coordinate system. Nondimensionalization of Navier stokes equation and nondimensional numbers; concept of scale up, Boundary Layer theory over a flat plate.

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Unit III
Shell energy Balances, Boundary conditions, Heat conduction with an Electrical Heat source, Heat conduction with a nuclear heat source, Heat conduction with a viscous heat source, Heat conduction through composite walls, Heat conduction in a cooling Fin forced convection, Free convection, Use of equations of change to setup steady state heat transfer problems.

Unit IV
Theory of diffusion in binary liquid, gas at low density, colloidal suspension, polymers, mass and molar transport by convection, Maxwell-Stefan equation. Shell mass balance, boundary conditions, diffusion through stagnant gas film, Diffusion with heterogeneous chemical reaction, diffusion with homogenous chemical reaction; diffusion into falling liquid film(absorption and solid dissolution), Steady State Diffusion and reaction inside porous catalyst, diffusion of three component system, Equations for change for multi component systems
   Convective mass transfer: concentration boundary layer, mass transport coefficient.

D. Reading Lists:
   Books:
1. *Byron R. Bird, Warren E. Stewart and Edwin N. Lightfoot, "Transport Phenomena, 2nd Edition", John Wiley & Sons, 2002.*
2. *Sissom L. E., and Pitts D. R., "Elements of Transport Phenomena", Mcgraw Hill, New York, 1972.*
3. *Brodkey R. S. and Hershey H. C., "Transport Phenomena – A United Approach", McGraw Hill, 1988.*
4. *R. W. Fahien, "Elementary Transport Phenomena", McGraw Hill, New York, 1983.*
5. *Welty J. R., Wicks C. E., Wilson R. E. And Rorer G. L., "Fundamentals of Momentum, Heat and Mass Transfer, 5th Edition", John Wiley & Sons, New York 2007.*

Journals:
1.   *Nature Chemistry*
2.   *Journal of Progress in Energy and Combustion Science*
3.   *Annual Review of Chemical and Biomolecular Engineering*
4.   *Journal of Fuel Processing Technology*
5.   *Journal of Chemical Engineering Science*
6.   *Journal of Chemical Engineering and Processing*
7.   *Journal of Industrial and Engineering Chemistry Research*
8.   *International Communications in Heat and Mass transfer*

Magazines:
1.   *Transport Phenomena, Aiche*

Name of the Module: Process Equipment Design & Drawing - II
Module Code: CHE - 703
Semester: 7th
Credit Value: 4 [P=1, T=0, L=3]

A. Objectives:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

The objective of this course is to acquire basic understanding of design parameter, complete knowledge of design procedures for commonly used process equipment and their attachments, and different types of equipment testing methods.

Detailed Process design of the following mass transfer equipment: Absorption towers - plate tower and packed tower. Venturi Scrubber. Distillation towers - plate tower and packed tower. Cooling towers, drying equipment. Crystallizer, adsorption column.

1. Detailed design and drawing using AUTOCAD of Sieve-tray column.
2. Detailed design and drawing using AUTOCAD of Extractor.
6. Detailed design and drawing using AUTOCAD of Distillation column.
7. Detailed design and drawing using AUTOCAD of cooling towers.
6. Detailed design and drawing using AUTOCAD of crystallizer.
7. Detailed design and drawing using AUTOCAD of Dryer.

B. Reading lists:
  Books:
  1. *J. M.Coulson and J.F.Richardson, "Chemical Engineering C Volume VI", Elsevier Press, VI Edition, 2006.*
  2. *R.E. Treybol, "Mass Transfer Operations", McGraw Hill, II Edition, 1981.*
  3. *Kern D.Q, "Process Heat Transfer", Mc.Graw Hill, 1950*
  4. *R.H.Perry and Don Green, "Chemical Engineer's Handbook", Mc.Graw Hill, VI Edition, 1984.*
Journals:
  1. *International Journal of Process Systems Engineering, Inder Science.*
  Chemical Engineering and Technology, Willey-VCH
Magazines:
  1. *Chemical Processing Magazine*
  2. *Process Worldwide Magazine*

Name of the Module: Project Work
Module Code: CHE - 704
Semester: 7th
Credit Value: 6 [P=6, T=0, L=0]

The students will have to carry out project work on a topic related to chemical engineering and allied subjects.

Name of the Module: Seminar
Module Code: CHE - 705
Semester: 7th

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Credit Value: 2 [P=2, T=0, L=0]

Name of the Module: Mass Transfer - II Lab
Module Code: CHE - 706
Semester: 7ᵗʰ
Credit Value: 3 [P = 3, T = 0, L = 0]

A. List of Experiments
1. Determination of diffusivity of vapour in air by Stefan's tube experiment
2. Determination of diffusivity of salt in water
3. Determination of the rate of evaporation of naphthalelne in air (Sublimation of naphthalene ball)
4. Estimation of rate of mass transfer of a gas in a solvent using Packed bed/Plate type absorber
5. Studies on hydrodynamic /flooding characteristics of tray tower
6. Studies on hydrodyanmic /flooding characteristics of packed tower
7. Prediction of adsorption isotherm
8. Studies on batch/continuous distillation of binary mixture
9. Studies on drying characteristics of material using Tray/Rotary/Vacuum dryer
10. Studies on water purification using ion-exchange column

SEMESTER VIII

Subject code	Subject	P	T	L	Credit
CHE - 801X	Elective - III	0	0	3	3
CHE - 802X	Elective - IV	0	0	3	3
CHE - 803	Project Work	12	0	0	6
CHE - 804	In- Plant Training	2	0	3	1
CHE - 805	Grand Viva	12	0	0	6
		26	0	6	19

Name of the Module: Elective - III
Module Code: CHE 802X
Semester: 8ᵗʰ
Credit Value: 3 [P=0, T=0, L=3]

Syllabi are given below

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Name of the Module: Elective - IV
Module Code: CHE 802X
Semester: 8ᵗʰ
Credit Value: 3 [P=0, T=0, L=3]

Syllabi are given below

Name of the Module: Project Work
Module Code: CHE - 803
Semester: 8ᵗʰ
Credit Value: 6 [P=12, T = 0, L= 0]

Students will be allotted project either individually or in groups. Each project will have one guide from the faculty. Students may be encouraged to choose co-guide from the industry, wherever possible. The aim of the project work is to evaluate the quality and competence developed by the students implementing theoretical concepts learned, in terms of technical report / presentation. The students may encourage to do Plant Design Project. Students will get opportunity to work as part of teams on departmental or multidisciplinary projects.

Name of the Module: In-Plant Training
Module Code: CHE - 804
Semester: 8ᵗʰ
Credit Value: 1 [P = 2, T = 0, L = 0]

In Plant Training will provide an industrial exposure to the students as well as to develop their career in the high tech industrial requirements. Reputed companies are providing inplant training to Students. Here students are initially get counseled in order to emerge out their interest in various streams and what are all the basic concepts they know on that domain.

Name of the Module: Grand Viva
Module Code: CHE - 805
Semester: 8ᵗʰ
Credit Value: 6 [P = 12, T = 0, L = 0]

There is no particular defined syllabus for the grand viva. Whatever will be taught in the four years of college could be asked in the grand viva.

Name of the Module: Nanotechnology
Module Code: CHE - 801A

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Semester: 8th
Credit Value: 3 [P = 0, T = 0, L = 3]

A. Objectives:
To enable the students to learn about basis of nanomaterial science, preparation method, types and application

B. Subject Matter:
Unit I:
    Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

Unit II:
    Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE. Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides- ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays90 functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications

Unit III:
    X-ray diffraction technique, Scanning Electron Microscopy – environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS Nanoindentation

Unit IV:
    NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging – Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

C. Reading Lists:
  Books:
1. *A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.*
2. *N John Dinardo, "Nanoscale charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000*
3. *Akhlesh Lakhtakia (Editor),"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.*
4. *G Timp (Editor), "Nanotechnology", AIP press/Springer, 1999.*

  Journals:
1. *Nature Chemistry*
2. *Journal of Progress in Energy and Combustion Science*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

3. *Annual Review of Chemical and Biomolecular Engineering*
4. *Journal of Fuel Processing Technology*
5. *Journal of Chemical Engineering Science*
6. *Journal of Chemical Engineering and Processing*
7. *Journal of Industrial and Engineering Chemistry Research*
8. *International Communications in Heat and Mass transfer*

Name of the Module: Polymer Technology
Module Code: CHE - 801B
Semester: 8ᵗʰ
Credit Value: 3 [P = 0, T = 0, L = 3]

A. Objectives:
To enable the students to compute molecular weight averages from the molecular weight distribution, Condensation polymerization and transition in polymers.

B. Subject Matter:
Unit I:
Introduction and Classification of Polymers. Thermosets, Factors influencing the polymer properties, Monomers used for polymer synthesis, synthesis procedure for monomers Styrene, ethylene, Vinyl monomers etc., Thermoplastics, Linear Branch, Cross Linked Polymers, Ewart Kinetics for emulsion polymerization. Addition polymers – kinetics, synthesis and reactions, Condensation polymers, Kinetics reaction and processes, Polymerization Techniques - Emulsion polymerization and Suspension polymerization, Interfacial Polymerization with their merits

Unit II:
Molecular Weights, Polydispersity Index, Different Methods of determination of Molecular weight, Effect of Molecular weight on Engineering Properties of Polymers, Smith Ewart Kinetics for emulsion polymerization, Kinetics of free radical polymerization, Chain transfer agents, Kinetics of Step growth polymerization, Ziegler Natta polymerization Processes, Differentiation based on kinetics of Anionic and cationic polymers.

Unit III:
Polymerization reactors types and mode of operation, Polymerization reactor design, control of polymerization, Post polymerization unit operations and unit processes High Performance and Specialty Polymers, Polymer additives, compounding. Fillers plastisizers lubricants colourants UV stabilizers, fire retardants, antioxidants, Different moulding methods of polymers.

Unit IV:
Impact flexural tensile testing methods of polymers, Mechanical Properties of Polymers, Thermodynamics of Polymer Mixtures, ASTM and ISO methods for testing of polymers.
Manufacturing of typical polymers with flow-sheet diagrams properties &application: PE, PP, PS, Polyesters, Nylons, ABS, PC.

C. Reading Lists:
Books:
1. *Fried J R, "Polymer Science and Technology", Prentice Hall of India Pvt. Ltd., New Delhi, Eastern Economy Edition, 2000.*
2. *Premamoy Ghosh, "Polymer Science and Technology", 3rd Edition, Tata Mc. Graw-Hill Publishing Company, New Delhi, 2010.*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

3. *R. Sinha, "Outlines of Polymer Technology: Manufacture of Polymers", Prentice Hall of India Pvt. Ltd., New Delhi, 2002.*

Journals:
1. *Nature Chemistry*
2. *Journal of Progress in Energy and Combustion Science*
3. *Annual Review of Chemical and Biomolecular Engineering*
4. *Journal of Fuel Processing Technology*
5. *Journal of Chemical Engineering Science*
6. *Journal of Chemical Engineering and Processing*
7. *Journal of Industrial and Engineering Chemistry Research*
8. *International Communications in Heat and Mass transfer*

Name of the Module: Frontiers of Chemical Engineering
Module Code: CHE - 801C
Semester: 8th
Credit Value: 3 [P = 0, T = 0, L = 3]

A. Objectives:
To enable the students to understand the chemical product design and available renewable energy resources.

B. Subject Matter:
Unit I:
> **Process Intensification:** Novel reactor configurations; combination of reaction and separation; use of different energy fields, lab on a chip.

Unit II:
> **Chemical Product Design:** Scope and importance; identification of needs and specifications; sources of ideas and screening ideas; selection of product idea; process development for product manufacture; specialty chemical manufacture; economic aspects.

Unit III:
> **Renewable Energy:** Hydrogen production, Hydrogen economy, Fuel Cell Technology, biofuel cellsand bio-hydrogen, solar energy

Unit IV:
> **Material Engineering:** Polymers and composites, ceramics and glasses, colloidal dispersions and nanoparticles, thin films and electronic materials
> **Bioengineering:** Biomechanics, biotransport and biomaterials, biomolecular and cellular engineering, drug discovery and development.

C. Reading Lists:
Books:
1. *Keil, F. J., "Modeling of Process Intensification", Wiley-VCH Verlag GmbH & Co. KGaA 2007*
2. *Cussler, E.l. and Moggridge, G.D., "Chemical Product Design" ,Cambridge University Press, Cambridge, 2001*

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

3. *Hoffmann,P, "Tomorrow's Energy: Hydrogen, Fuel Cells, and the Prospects for a Cleaner Planet", MIT Press, Sabon, 2002*
4. *Mitchell, B.S., "An Introduction to Materials Engineering and Science for Chemical and Materials Engineers", John Wiley and Sons Inc., New Jersey, 2004*

Journals:
1. *Nature chemistry*
2. *Journal of progress in energy and combustion science*
3. *Annual review of chemical and biomolecular engineering*
4. *Journal of fuel processing technology*
5. *Journal of chemical engineering science*
6. *Journal of chemical engineering and processing*
7. *Journal of industrial and engineering chemistry research*
8. *International communications in heat and mass transfer*

Name of the Module: Colloid and Interface Science and Engineering
Module Code: CHE - 802A
Semester: 8th
Credit Value: 3 [P = 0, T = 3, L = 3]

Subject Matter:
Unit I:
Introduction to colloidal dispersion; Technological and biological significance of colloidal dispersions; Classification of colloids; Some typical colloidal dispersions; Properties of colloidal systems; Experimental characterization of colloidal dispersions; Introduction to Surface and interfacial tension; Shape of the surfaces: curvature and radius of curvature; Young-Laplace equation Capillarity; Young's Equation Contact angle, adhesion and wetting phenomena; Wetting of Rough, Textured; and Chemically Heterogeneous Surfaces; Contact Angle Hysteresis;

Unit II
Adsorption at fluid-fluid and fluid-solid interfaces; Adsorption of surfactants; Gibbs and Langmuir monolayers; Gibbs adsorption equation; Surface equation of state; Surface pressure isotherm; Langmuir-Blodgett films and their applications; Radiotracer and neutron reflection techniques for studying adsorption at fluid-fluid interfaces; Henry, Freundlich, Langmuir, Frumkin and Davies adsorption isotherms; Brunauer-Emmett-Teller theory of adsorption; Adsorption hysteresis; Characterization of adsorption at fluid-solid interfaces by vacuum and non-vacuum techniques.

Unit III:
Intermolecular and surface forces; van der waal forces between macroscopic bodies, van der Waals energy of interaction between curved bodies Deryaguin's approximation

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH
(Established by Ministry of Human Resources Development, Govt. Of India)
Yupia, District Papum Pare, Arunachal Pradesh – 791112
Fax: 0360 – 2284927, E-mail: directornitap@gmail.com
SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Electrostatic interaction; surface charges and electrical double layer, the capacitor model of the double layer, the diffuse double layer: the Debye-Huckel approximation, Gouy-Chapman theory, overlapping double layers and interparticle repulsion; stability of colloidal system

Unit IV:

Electrokinetic Phenomena: introduction; mobility of small ions and macro-ions in electric fields; zeta potential, electrophoresis; electroosmosis, streaming potential; sedimentation potential; applications of electrokinetic phenomena

Reading Lists:

1. P. C. Hiemenz and R. Rajagopalan "*Principles of Colloid and Surface Chemistry*," 3rd Edition, CRC Press, 1997.
2. W. Adamson, "*Physical Chemistry of Surfaces*," 5th edition, Wiley, 1990.
3. Robert J. Hunter, "Foundations of Colloid Science," Clarendon, Oxford, Volumes 1 & 2, 1989.
4. J. N. Israelachvili, "*Intermolecular and Surface Forces*," 3rd Edition, Academic Press, 2011.

Name of the Module: Biochemical Engineering

Module Code: CHE - 802B

Semester: 8th

Credit Value: 3 [P = 0, T = 3, L = 3]

Subject Matter:

Unit I

Principles of enzyme catalysis

Proteins as enzymes; Michaelis-Menten kinetics; kinetics and statistics; inhibition; effect of pH and temperature; enzymology; immobilized enzymes: methods, mass transfer considerations; Industrial enzymes. Immobilized enzyme kinetics and its application.

Unit II

Microbial growth

Introduction to metabolism; nutrient transport; glycolysis; TCA cycle and other pathways; control of metabolism; Factors affecting microbial growth; Stoichiometry: mass balances; Stoichiometry: energy balances; Growth kinetics; Measurement of growth.

Unit III

Bioreactors

Introduction to bioreactors; Batch and Fed-batch bioreactors, Continuous bioreactors; Immobilized cells; Membrane bioreactors

Bioreactor operation; Sterilization: Batch and Continuous sterilization; Aeration: Mass transfer kinetics; Sensors; Instrumentation; Culture-specific design aspects: Bacterial/mammalian cell culture reactors.

Unit IV

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

Bioseparations

Biomass removal; Biomass disruption; Membrane-based techniques for ultra-filtration;
Extraction; Adsorption and Chromatography.

Industrial Processes and Process economics

Description of industrial processes; Process flow sheeting; Process economics

Reading Lists:

1. J. E. Bailey and D. F. Ollis, "*Biochemical Engineering Fundamentals,*" 2nd Ed., McGraw Hill, 1986.
2. P. M. Doran, "*Bioprocess Engineering Principles,*" 2nd Edition Elsevier 2012.
3. B. Atkinson, "*Biochemical Reactors*", Pion Ltd., London, 1974.
4. S. Aiba, A. E. Humhrey and N. F. Mills, "*Biochemical Engineering,*" 2nd Ed., Academic Press, New York, 1973.
5. M. L. Schuler and F. Kargi, *Bioprocess Engineering: Basic Concepts*, 2nd Ed., Prentice Hall, International Series, 2002.
R. Dutta, "Fundamentals of Biochemical Engineering", Springer Publications, (2010).

Name of the Module: Materials Technology
Module Code: CHE - 802C
Semester: 8th
Credit Value: 3 [P = 0, T = 3, L = 3]

A. Objectives:

The student will be able to: Explain the differences in properties of different materials, including metals, alloys, ceramics, polymers and composites, Relate the properties of materials to microstructure (quantitative skills), Discuss new fields of micro-electro-mechanical-systems (MEMS) and nanotechnology and Describe the basics of processing techniques for altering the microstructure and properties of different materials

B. Subject Matter:
Unit I:
   Engineering Materials: Classification, study of ferrous and non ferrous materials Phase diagrams of steel, brass and cupronickel and the applications of phase diagrams.
Unit II:
   Modification and control of material properties. Non metallic materials: Thermo settings and thermoplastics.
Unit III:
   Inorganic materials, composite materials and smart materials Corrosion Engineering: Electrochemical principles, different types of corrosion, mechanisms of corrosion control and prevention, preventive coatings.
Unit IV:
   Corrosion behavior of important alloys such as stainless steels,brass etc. Theory of failure: Crystal defects, plastic deformation. Types of mechanical failure, fracture, fatigue and creep. Criteria for selection of materials in chemical process industry
C. Reading Lists:
   Books:

NATIONAL INSTITUTE OF TECHNOLOGY, ARUNACHAL PRADESH

(Established by Ministry of Human Resources Development, Govt. Of India)

Yupia, District Papum Pare, Arunachal Pradesh – 791112

Fax: 0360 – 2284927, E-mail: directornitap@gmail.com

SYLLABUS FOR B-TECH (CHEMICAL ENGINEERING)

1. *"Material Science and Engineering Metallurgy",* Agrawal B. K.
2. *"Materials Science and Engineering",* Raghavan V.
3. *"Materials Science and Engineering",* Van Vlack L.H.
4. *"Engineering Materials and Applications",* Flin R.A., Trojan P.K.

Journals:
   (i) *Journal of Materials Processing Technology – Science Direct*
   (ii) *Journal of Engineering Materials and Technology, ASME*

Magazines:
   (i) *Materials Today*
   (ii) *Discover Magazine*