Dr. Babasaheb Ambedkar Technological University

(Established as a University of Technology in the State of Maharashtra)(Under Maharashtra Act No. XXIX of 2014)

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Proposed Course Contents for

B. Tech. in Food Technology and Management
w.e.f. June 2021

From 1st Semester - 8th Semester

Dr. Babasaheb Ambedkar Technological University, Lonere.

Faculty of Engineering and Technology Branch :- Food Engineering and Technology

Proposed Struture 2021-22

Semester I									
Course Code	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				
		L	T	P	CA	MSE	ESE	Total	Credit
Mandetory	**Induction Program**	**3-weeks duration in the beginning of semester.**							
BTBS101	Engineering Mathematics- I	3	1	-	20	20	60	100	4
BTBS102	Engineering Physics	3	1	-	20	20	60	100	4
BTES103	Engineering Graphics	2	-	-	20	20	60	100	2
BTHM104	Communication Skills	2	-	-	20	20	60	100	2
BTES105	Energy and Environment Engineering	2	-	-	20	20	60	100	2
BTES106	Basic Civil and Mechanical Engineering	2	-	-	50	-	-	50	Audit
BTBS107L	Engineering Physics Lab	-	-	2	60	-	40	100	1
BTES108L	Engineering Graphics Lab	-	-	4	60	-	40	100	2
BTHM109L	Communication Skills Lab.	-	-	2	60	-	40	100	1
		14	**2**	**8**	**330**	**100**	**420**	**850**	**18**
Semester II									
BTBS201	Engineering Mathematics-II	3	1	-	20	20	60	100	4
BTBS202	Engineering Chemistry	3	1	-	20	20	60	100	4
BTES203	Engineering Mechanics	2	1	-	20	20	60	100	3
BTES204	Computer Programming in C	2	-	-	20	20	60	100	2
BTES205	Workshop Practices	-	-	4	60	-	40	100	2
BTES206	Basic Electrical and Electronics Engineering	2	-	-	50	-	-	50	Audit
BTES207L	Computer Programming Lab	-	-	2	60	-	40	100	1
BTBS208L	Engineering Chemistry Lab	-	-	2	60	-	40	100	1
BTES209L	Engineering Mechanics Lab	-	-	2	60	-	40	100	1
BTES210P	Mini Project	-	-	2	60	-	40	100	1
BTES211P	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time).	**-**	**-**	**-**	-	-	-	-	Credits To be evaluated in III Sem.
		12	**3**	**12**	**430**	**80**	**440**	**950**	**19**
		27							

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Subject code	Semester-III	Teaching Scheme			Evaluation Scheme				
	Subjects	L	T	P	CA	MSE	ESE	TOTAL	Credits
BTBS301	Engineering Mathematics-III	3	1	-	20	20	60	**100**	4
BTFT302	Fluid Flow	3	1	-	20	20	60	**100**	4
BTFT303	Process Plant Material & Energy Balance	3	1	-	20	20	60	**100**	4
BTFT304	Element of Bio & Food Science	3	-	-	20	20	60	**100**	4
BTFT305	Food Processing Lab 01	-	-	4	60	-	40	**100**	2
BTFT306	Food Processing Lab 02	-	-	4	60	-	40	**100**	2
BTFT307	Food Processing Lab 03	-	-	4	60	-	100	**160**	1
BTFT308	Intership-I Evaluvation	-	-	0	-	-	40	**40**	1
	Total	**12**	**3**	**12**	**260**	**80**	**460**	**800**	22
	Total Contact hours/week	**27**			**800**				

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Subject code	Semester-IV	Teaching Scheme			Evaluation Scheme				
	Subjects	**L**	**T**	**P**	**CA**	**MSE**	**ESE**	**TOTAL**	**Credits**
BTFT401	Human Rights Management	3	1	-	20	20	60	**100**	4
BTFT402	Chemical Engineering Thermodynamics	3	1	-	20	20	60	**100**	4
BTFT403	Food Chemistry	3	-	-	20	20	60	**100**	3
BTFT404	Food Microbiology	3	1	-	20	20	60	**100**	4
BTFT405	Elective-I	3	-	-	20	20	60	**100**	3
BTFT406	Food Processing Lab-4	-	-	4	60	-	40	**100**	2
BTFT407	Food Processing Lab-5	-	-	4	60	-	40	**100**	2
BTFT408	Field Taining/Intership/Industrial Training (Minimum of 4 weeks which completed partially in the third and fourth semester or in one semester itself)	-	-	-	-	-	-	-	Credits to be Evaluated in sem V
	Total	**15**	**3**	**8**	**220**	**100**	**380**	**700**	22
	Total Contact hours/week	**26**			**700**				

Subject code	Elective-I
405A	Strenth of matrials
405B	Machanical Operations
405C	Numerical Methods in chemical Engineering
405D	Organic Chemistry

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Subject code	Semester-V	Teaching Scheme			Evaluation Scheme				
	Subjects	**L**	**T**	**P**	**CA**	**MSE**	**ESE**	**TOTAL**	**Credits**
BTFT501	Beverage Technology	3	-	-	20	20	60	**100**	3
BTFT502	Mass Transfer-I	3	1	-	20	20	60	**100**	4
BTFT503	Food Business Management	3	1	-	20	20	60	**100**	4
BTFT504	Processing of cereasl & Palses	3	-	-	20	20	60	**100**	3
BTFT505	Processing of Frouits and Vegetables	3	-	-	20	20	60	**100**	3
BTFT506	Process Equipent Design Lab	-	-	2	30	-	20	**50**	1
BTFT507	Food Processing Lab-6	-	-	2	30	-	20	**50**	1
BTFT508	Food Processing Lab-7	-	-	4	60	-	40	**100**	2
BTFT509	Intership-2 Evaluation	-	-	-	-	-	100	**100**	1
	Total	**15**	**2**	**8**	**220**	**100**	**480**	**800**	22
	Total Contact hours/week	**25**			**800**				

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Subject code	Semester-VI	Teaching Scheme			Evaluation Scheme				
	Subjects	L	T	P	CA	MSE	ESE	TOTAL	Credits
601	Mass Transfer-II	3	1	-	20	20	60	**100**	4
602	Supply Chain & Logsties Management	3	1	-	20	20	60	**100**	4
603	Meat Fish & Poultry Technology	3	1	-	20	20	60	**100**	4
604	Elective-II	3	0	-	20	20	60	**100**	3
605	Open Elective-I	3	-	-	20	20	60	**100**	3
606	Process Plant Design-II	-	-	4	60	-	40	**100**	1
607	Food Processing Lab-8	-	-	4	60	-	40	**100**	2
608	Food Processing Lab-9	-	-	4	60	-	40	**100**	2
609	Field Taining/Intership/Industrial Training (Minimum of 4 weeks which completed partially in the third and fourth semester or in one semester itself)	-	-	-	-	-	-	-	Credits to be Evaluated in sem VII
	Total	**15**	**3**	**12**	**280**	**100**	**420**	**800**	23
	Total Contact hours/week	**26**			**900**				

	Elective-II
604A	Confectenery Technology
604B	Nano Technology
604C	Chemical Reaction Engineering
604D	Functional Food
	Open Elective-I
605A	Process Instrumentation
605B	Processing of oil seeds, oil & fats
605C	Food Rheology & Texture
605D	Heat Transfer
605E	Wheat Milling and Baking Technology

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Subject code	Semester-VII	Teaching Scheme			Evaluation Scheme				
	Subjects	L	T	P	CA	MSE	ESE	TOTAL	Credits
701	Project Management & Entrepreneurship	3	1	-	20	20	60	**100**	4
702	Food Regulation & Quality Control	3	1	-	20	20	60	**100**	4
703	Processing of Milk and Milk Products	3	1	-	20	20	60	**100**	4
704	Elective-III	3	0	-	20	20	60	**100**	3
705	Open Elective-II	3	-	-	20	20	60	**100**	3
706	Food Processing Lab-10	-	-	2	60	-	40	**100**	1
	Food Processing Lab-11	-	-	2	60	-	40	**100**	1
	Project Work (Food Process Plant Design-III)	-	-	2	60	-	40	**100**	1
707	Industrial Traing & Seminar	-	-	2	40	-	60	**100**	1
708	Internship-III Evaluation	-	-	-	-	-	100	**100**	1
	Total	**15**	**3**	**8**	**320**	**100**	**580**	**1000**	23
	Total Contact hours/week	**23**			**800**				

	Elective-III
704A	Biochemical Engineering
704B	Food Biotechnology
704C	Plant Utilities
704D	Food Referigeration & Cold Storage
	Open Elective-II
705A	Operation Research
705B	Process Dynamic & Control
705C	Industrial Safety and Hazards
705D	Packaging Technology
705E	Operation Research

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Subject code	Semester-VIII	Teaching Scheme			Evaluation Scheme				
	Subjects	L	T	P	CA	MSE	ESE	TOTAL	Credits
801	Project Work / Intership	-	-	24	60	-	40	**100**	12
	Total	**0**	**0**	**24**	**60**	**0**	**40**	**100**	12
	Total Contact hours/week	**25**			**800**				

Guide to Induction Program

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Precious little is done by most of the institutions, except for an orientation program lasting a couple of days.

We propose a 3-week long induction program for the UG students entering the institution, right at the start. Normal classes start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awarness, sensitivity and understanding of the self, people around them, society at large, and nature.

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

- **Physical Activity** This would involve a daily routine of physical activity with games and sports. It would start with all students coming to the field at 6 am for light physical exercise or yoga. There would also be games in the evening or at other suitable times according to the local climate. These would help develop team work. Each student should pick one game and learn it for three weeks. There could also be gardening or other suitably designed activity where labour yields fruits from nature.
- **Creative Arts** Every student would chose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.
- **Universal Human Values:** It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. Need for character building has been underlined earlier. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values. The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program. Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.
- **Literary** Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.
- **Proficiency Modules:** This period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.
- **Lectures by Eminent People** This period can be utilized for lectures by eminent people, say, once a week. It would give the students exposure to people who are socially active or in public life.

- **Visits to Local Area** A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.
- **Familiarization to Dept./Branch & Innovations :** The students should be told about different method of study compared to coaching that is needed at IITs. They should be told about what getting into a branch or department means what role it plays in society, through its technology.

They should also be shown the laboratories, workshops & other facilties.

Schedule

The activities during the Induction Program would have an ***Initial Phas***e, a ***Regular Phase*** and a ***Closing Phase***. The Initial and Closing Phases would be two days each.

Initial Phase

Time	Activity
Day 0	
Whole day	Students arrive - Hostel allotment. (Preferably do preallotment)
Day 1	
9.00 AM to 3.00 PM	Academic Registration
4.30 PM to 6.00 PM	Ori Orientation
Day 2	
9.00 AM to 10.00 AM	Diagnostic test (for English etc.)Visi
10.15 AM to 12.25 PM	Visits to Respective Departments
12.30 to 2.00	Lunch time
2.00 PM to 3.00 PM	Director's Speech
3.00 PM to 4.00 PM	Interaction with Parents
4.00 PM to 5.30 PM	Mentor-Mentee groups- Introduction within group

Regular Phase

After two days is the start of the Regular Phase of induction. With this phase there would be regular program to be followed every day.

Daily Schedule

Some of the activities are on a daily basis, while some others are at specified periods within theInduction Program. We first show a typical daily timetable.

Session	Time	Activity	Remark
Day 3 Onwards			
I	9.00 AM to 11.00AM	Creative Arts / Universal Human Values	Half the groups will do creative arts
II	11.00 AM to 1.00 PM	Universal Human Values/ Creative Arts	Complementary Alternate
Lunch Time			
IV	2.00 PM to 4.00 PM	Afternoon Session	See below
V	4.00 PM to 5.00 PM	Afternoon Session	See below

Sundays are off. Saturdays have the same schedule as above or have outings.

Afternoon Activities (Non-Daily) : The following five activities are scheduled at different timesof the Induction Program, and are not held daily for everyone:

1. Familiarization to Dept./Branch & Innovations
2. Visits to Local Area
3. Lectures by Eminent People
4. Literary
5. Proficiency Modules

Closing Phase

Time	Activity
Last But one day	
9.00 AM to 12.00 PM	Discussions and finalizations of presentations within each group
2.00 PM to 5.00 PM	Presentation by each group in front of 4 other groups besides theirown (about 100 students)
Last Day	
Whole day	Examinations if any

Follow Up after Closure

A question comes up as to what would be the follow up program after the formal 3-week Induction Program is over? The groups which are formed should function as mentor- mentee network. A student should feel free to approach his faculty mentor or the student guide, when facing any kind of problem, whether academic or financial or psychological 6etc. (For every 10 undergraduate first year students, there would be a senior student as a student guide, and for every 20 students, there would be a faculty mentor.) Such a group should remain for the entire 4-5 year duration of the stay of the student. Therefore, it would be good to have groups with the students as well as teachers from the same department/discipline Here we list some important suggestions which have come up and which have been experimented with.

- **Follow Up after Closure – Same Semester:** It is suggested that the groups meet with their faculty mentors once a month, within the semester after the 3-week Induction Program is over. This should be a scheduled meeting shown in the timetable. (The groups are of course free to meet together on their own more often, for the student groups to be invited to their faculty mentor's home for dinner or tea, nature walk, etc.)
- **Follow Up – Subsequent Semesters:** It is extremely important that continuity be maintained in subsequent semesters. It is suggested that at the start of the subsequent semesters (upto fourth semester), three days be set aside for three full days of activities related to follow up to Induction Program. The students be shown inspiring films, do collective art work, and group discussions be conducted. Subsequently, the groups should meet at least once a month.

Summary

Engineering institutions were set up to generate well trained manpower in engineering with a feeling of responsibility towards oneself, one's family, and society. The incoming undergraduate students are driven by their parents and society to join engineering without understanding their own interests and talents. As a result, most students fail to link up with the goals of their own institution. The graduating student must have values as a human being, and knowledge and meta-skills related to his/her profession as an engineer and as a citizen. Most students who get demotivated to study engineering or their branch, also lose interest in learning.

The Induction Program is designed to make the newly joined students feel comfortable, sensitize them towards exploring their academic interests and activities, reducing competition and making them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and building of character.

The Universal Human Values component, which acts as an anchor, develops awareness and sensitivity, feeling of equality, compassion and oneness, draw attention to society and 4

We are aware that there are advantages in mixing the students from different depts. However, in mixing, it is our experience that the continuity of the group together with the faculty mentor breaks down soon after. Therefore, the groups be from the same dept. but hostel wings have the mixed students from different depts. For example, the hostel room allotment should be in alphabetical order irrespective of dept. 7nature, and character to follow through. It also makes them reflect on their relationship with their families and extended family in the college (with hostel staff and others). It also connects students with each other and with teachers so that they can share any difficulty they might be facing and seek help.

References:

Motivating UG Students Towards Studies, Rajeev Sangal, IITBHU Varanasi, Gautam Biswas, IIT Guwahati, Timothy Gonsalves, IIT Mandi, Pushpak Bhattacharya, IIT Patna, (Committee of IIT Directors),

31 March 2016, IIT Directors' Secretariat, IIT Delhi.

Engineering Mathematics – I

Unit 1:Linear Algebra- Matrices

Inverse of a matrix by Gauss-Jordan method; Rank of a matrix; Normal form of a matrix ; Consistency of non-homogeneous and homogeneous system of linear equations ; Eigen values and eigen vectors ; Properties of eigen values and eigen vectors (without proofs); Cayley- Hamilton's theorem (without proof) and its applications. **[6 Hours]**

Unit 2:Partial Differentiation

Partial derivatives of first and higher orders; Homogeneous functions – Euler's Theorem for functions containing two and three variables (with proofs); Total derivatives; Change of variables.

[06 Hours]

Unit 3:Applications of Partial differentiation

Jacobians - properties; Taylor's and Maclaurin's theorems (without proofs) for functions of two variables; Maxima and minima of functions of two variables; Lagrange's method of undetermined multipliers. **[06 Hours]**

Unit 4: Reduction Formulae and Curve Tracing

Reduction formulae for $\int_0^{\frac{\pi}{2}} \sin^n x\,dx$, $\int_0^{\frac{\pi}{2}} \cos^n x\,dx$, $\int_0^{\frac{\pi}{2}} \sin^m x \cos^n x\,dx$; Tracing of the curves given in Cartesian, parametric & polar forms. **[06 Hours]**

Unit 5: Multiple Integrals

Double integration in Cartesian and polar co-ordinates; Evaluation of double integrals by changing the order of integration and changing to polar form; Triple integral; Applications of multiple integrals to find area as double integral , volume as triple integral and surface area.

[08 Hours]

Text Books

1) Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2) Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
3) A Course in Engineering Mathematics (Vol I) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.
4) A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan, Pune.
5) Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO.Pvt. Ltd., New Delhi.

Reference Books

1) Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2) A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. , Singapore.
3) Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.

General Instructions:

The tutorial classes in Engineering Mathematics-I are to be conducted batchwise. Each class shouldbe divided into three batches for the purpose.

The internal assessment of the students for 20 marks will be done based on assignments, surprisetests, quizzes, innovative approach to problem solving and percentage attendance.

The minimum number of assignments should be eight covering all topics.

BTBS102/ BTBS202 Engineering Physics

Objectives:-

1. To provide a firm grounding in the basic physics principles and concept to resolve many Engineering and technological problems.

2. To understand and study the Physics principles behind the developments of Engineering materials.

Unit I

Oscillatio, Ultrasonics and Dielectric Materials: (06 Hrs)

Free oscillation, damped oscillation, Forced oscillation and Resonance, differential wave equation, Ultrasonic waves, production of ultrasonics (Piezoelectric effect, Magnetostriction effect) and itsapplications.

Dielectric parameters (Dielectric constant, Electric displacement, Polarization & Polarizability),Types of polarization, temperature and frequency dependences of dielectric materials.

Unit II

Optics, Fibre Optics and Laser: (06 Hrs)

Interference of light in thin film, wedge shaped film , Newton's rings, polarization of light, methods for production of polarized light(Reflection, Refraction& Double refraction), Huygen's theory of double refraction, Laurent's half shade Polarimeter, Principle and structure of optical fibre, acceptance angle, acceptance cone, numerical aperture.

Principle of laser, Einstein's coefficients, Types of laser – Ruby and He-Ne laser and their applications.

Unit III

Electron Optics, Nuclear Physics and Quantum Mechanics: (06 Hrs)

Measurement of 'e/m' by Thomson's method, Determination of electronic charge by Millikan's oil drop method, Bainbridge mass spectrograph,

G.M. counter, Heisenberg's uncertainty principle, Schrödinger's time dependent and timeindependent wave equations, physical significance of wave function.

Unit IV

Crystal Structure, X-rays and Electrodynamics: (06 Hrs)

Unit cell, Bravais lattice, cubic system, number of atoms per unit cell, coordination number, atomicradius, packing density, relation between lattice constant and density, lattice planes and Miller indices, Interplaner spacing for cubic system, Bragg's law, X-ray diffraction, Line and ContinuousSpectrum of X-ray, Mosley's law. Introduction of Maxwell equations(no derivation), Electromagnetic wave in free space.

Unit V

Magnetic, Superconducting and Semiconducting materials: (06 Hrs)

Types of magnetic materials(Ferrimagnetic & Antiferromagnetic, Ferrites & Garnets), B-H curve,Classical free electron theory-electrical conductivity, resistivity and its temperature dependence,microscopic Ohm's law, Superconductivity, types of superconductors, Meissner effect and Applications. Band theory of solids, conductivity of semiconductors, Hall effect.

Expected Outcome:-

1. The student will be able to understand Engineering problems based on the principle of Oscillation, Ultrasonics, Optics, Laser, Fibre optics, Nuclear physics, Quantum mechanics.
2. The student will be able to understand Fundamental of Electrodynamics, Semiconductor, Dielectric, Magnetic and Superconducting materials which forms the base of many modern devices and technologies.

Text books:

1. Engineering Physics M.N. Avadhanulu and P.G. Kshirsagar. S.Chand andCompany LTD.
2. Engineering Physics – Dr. L. N. Singh. Synergy Knowledgeware-Mumbai.

3. Engineering Physics - R.K. Gaur and S. L. Gupta. Dhanpat Rai PublicationsPvt. Ltd.-New Delhi.
4. Fundamental of Physics - Halliday and Resnik. Willey Eastern Limited.

Reference books:

1. Introduction to Electrodynamics –David R. Griffiths.
2. Concept of Modern Physics – Arthur Beizer. Tata McGraw-Hill Publishing Company Limited.
3. Optics – Ajoy Ghatak.MacGraw Hill Education (India) Pvt. Ltd.
4. Science of Engineering Materials- C.M. Srivastava and C. Srinivasan. New Age International Pvt.Ltd.
5. Solid State Physics – A.J. Dekker. McMillan India –Limited.
6. The Feynman Lectures on Physics Vol I,II,III.
7. Introduction to solid state physics – Charles Kittel. John Willey and Sons

Engineering Physics Lab.

At least 10 experiments should be performed from the following list.

1. Newton's rings - Determination of radius of curvature of Plano convex lens / wavelength of light
2. Wedge Shaped film - Determination of thickness of thin wire
3. Half shade Polarimeter - Determination of specific rotation of optically active material
4. Laser - Determination of wavelength of He-Ne laser light
5. Magnetron Tube - Determination of 'e/m' of electron
6. G.M. Counter - Determination of operating voltage of G.M. tube
7. Crystal Plane – Study of planes with the help of models related Miller Indices
8. Hall Effect - Determination of Hall Coefficient
9. Four Probe Method - Determination of resistivity of semiconductor
10. Measurement of Band gap energy of Semiconductors
11. Study of I-V characteristics of P-N junction diode
12. Experiment on fibre optics
13. Ultrasonics Interferometer
14. B-H Curve Experiment
15. Susceptiblity measurement experiment

BTES103/203 Engineering Graphics

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks (Duration 04 hrs)

Unit 1: Drawing standards and geometrical construction: 4hrs

Drawing standard SP: 46, Type of lines, lettering, dimensioning, scaling conventions. Geometrical construction: Dividing a given straight line into any number of equal parts, bisecting a given angle, drawing a regular polygon given one side, special methods of constructing a pentagon and a hexagon.

Unit 2: Orthographic Projections and Projections of Points: 4hrs

Introduction to orthographic projection, drawing of orthographic views of objects from their isometric views. Projection of points lying in four quadrants.

Unit 3: Projections of Straight Lines and Planes and their Traces : 4hrs

Projections of lines parallel and perpendicular to one or both planes, projections of lines inclined toone or both planes. Traces of lines.

Projections of planes parallel and perpendicular to one or both planes, projection of planes inclinedto one or both planes.

Unit 4: Projections of Solids 4hrs

Types of solids, projections of solids with axis perpendicular and parallel to HP and VP, solids withaxis inclined to one or both the planes. Projections of spheres touching each other.

Unit 5: Sectioning of Solids, Isometric Projections 4hrs

Sectioning of solids: Section planes perpendicular to one plane and parallel or inclined to otherplane. Isometric projections: Isometric scale, drawing of isometric projections from given orthographic views.

Reference/Text Books:

1. N. D. Bhatt, *Engineering Drawing*, Charotar Publishing House, 46th Edition, 2003.
2. K. V. Nataraajan, *A text book of Engineering Graphic*, Dhanalakshmi Publishers, Chennai, 2006.
3. K. Venugopal and V. Prabhu Raja, *Engineering Graphics*, New Age International (P) Ltd, 2008.
4. Dhananjay A. Jolhe, *Engineering Drawing with an Introduction to Autocad*, McGraw Hill Education, 2017

Engineering Graphics Lab

Practical Scheme:	Examination Scheme:
Practical: 4 hrs/batch	Internal Assessment: 60 Marks External Exam: 40 Marks

List of Practical:

1. Lines, lettering and dimensioning.
2. Geometrical Constructions.
3. Orthographic projections.
4. Projections of points.
5. Projections of straight lines.
6. Projections of planes.
7. Projections of solids.
8. Section of solids.
9. Isometric Projections.

Communication Skills

Unit 1: Communication and Communication Processes **(04 hrs)**

Introduction to Communication, Forms and functions of Communication, Barriers toCommunication and overcoming them, Verbal and Non-verbal Communication

Reading: Introduction to Reading, Barriers to Reading, Types of Reading: Skimming, Scanning,Fast Reading, Strategies for Reading, Comprehension.

Listening : Importance of Listening, Types of Listening, Barriers to Listening.

Unit 2: Verbal & Non-verbal Communication **(04 hrs)** Use of Language in Spoken Communication, Principles and Practice of Group Discussion, PublicSpeaking (Addressing Small Groups and Making Presentation), Interview Techniques, AppropriateUse of Non-verbal Communication, Presentation Skills, Extempore, Elocution.

Unit 3: Study of Sounds in English ***(02 hrs)***

Introduction to phonetics, Study of Speech Organs, Study of Phonemic Script, Articulation ofDifferent Sounds in English.

Unit 4: English Grammar ***(05 hrs)***

Grammar: Forms of Tenses, Articles, Prepositions, Use of Auxiliaries and Modal Auxiliaries,Synonyms and Antonyms, Common Errors.

Unit 5: Writing Skills, Reading Skills & Listening Skills **(04 hrs)**

Features of Good Language, Difference between Technical Style and Literary Style, Writing Emails, Formal and Informal English, Technical Reports: Report Writing: Format, Structure andTypes

Letter Writing: Types, Parts, Layouts, Letters and Applications, Use of Different Expressions andStyle, Writing Job Application Letter and Resume.

Text book:

Mohd. Ashraf Rizvi, *Communication Skills for Engineers*, Tata McGraw Hill

Reference Books:

1) Sanjay Kumar, Pushp Lata, *Communication Skills*, Oxford University Press, 2016
2) Meenakshi Raman, Sangeeta Sharma, *Communication Skills*, Oxford University Press, 2017
3) Teri Kwal Gamble, Michael Gamble, *Communication Works*, Tata McGraw Hill Education, 2010
4) Anderson, Kenneth. Joan Maclean and Tossny Lynch. Study Speaking: A Course in Spoken English for Academic Purposes. Cambridge: CUP, 2004.
5) Aswalthapa, K. *Organisational Behaviour*, Himalayan Publication, Mumbai (1991).
6) Atreya N and Guha, *Effective Credit Management*, MMC School of Management, Mumbai (1994).
7) Balan,K.R. and Rayudu C.S., *Effective Communication*, Beacon New Delhi (1996).
8) Bellare, Nirmala. *Reading Strategies*. Vols. 1 and 2. New Delhi. Oxford University Press, 1998.
9) Bhasker, W. W. S & Prabhu, N. S.: *English through Reading*, Vols. 1 and 2. Macmillan, 1975.
10) Black, Sam. *Practical Public Relations*, E.L.B.S. London (1972).
11) Blass, Laurie, Kathy Block and Hannah Friesan. *Creating Meaning*. Oxford: OUP, 2007.
12) Bovee Courtland,L and Thrill, John V. *Business Communication*, Today McGraw Hill, New York, Taxman Publication (1989).

Communication Skills Lab

List of Practicals (Any 10 PR sessions can be conducted)

1) How to introduce oneself ? (02 hrs)
2) Introduction to Phonemic symbols (02 hrs)
3) Articulation of sounds in English with proper manner (02 hrs)
4) Practice and exercises on articulation of sounds (02 hrs)
5) Read Pronunciations/transcriptions from the dictionary (02 hrs)
6) Practice and exercises on pronunciations of words (02 hrs)
7) Introduction to stress and intonation (02 hrs)
8) Rapid reading sessions (02 hrs)
9) Know your friend (02 hrs)
10) How to introduce yourself (02 hrs)
11) Extempore (02 hrs)
12) Group discussion (02 hrs)
13) Participating in a debate (02 hrs)
14) Presentation techniques (02 hrs)
15) Interview techniques (02 hrs)

Energy and Environment Engineering

Unit 1

Conventional Power Generation: Steam power station, Nuclear power plant – Gas turbine power plant- Hydro power station: Schematic arrangement, advantages and disadvantages, Thermo electric and thermionic generators, Environmental aspects for selecting the sites and locations of powerplants. [**4 hrs]**

Unit 2

Renewable Power Generation: Solar, Wind, Biogas and Biomass, Ocean Thermal energy conversion (OTEC), Tidal, Fuel cell, Magneto Hydro Dynamics (MHD): Schematic arrangement, advantages and disadvantages. [**4 hrs]**

Unit 3

Energy conservation: Scope for energy conservation and its benefits Energy conservation Principle – Maximum energy efficiency, Maximum cost effectiveness, Methods and techniques of energy conservation in ventilation and air conditioners, compressors, pumps, fans and blowers, Energy conservation in electric furnaces, ovens and boilers., lighting techniques. [**4 hrs]**

Unit 4

Air Pollution: Environment and Human health - Air pollution: sources- effects- control measures -Particulate emission, air quality standards, and measurement of air pollution. [**4 hrs]**

Unit 5

Water Pollution: Water pollution- effects- control measures- Noise pollution –effects and control measures, Disposal of solid wastes, Bio-medical wastes-Thermal pollution – Soil pollution -Nuclear hazard. [**4 hrs]**

Reference/Text Books:

1. A Chakrabarti, M. L Soni, P. V. Gupta, U. S. Bhatnagar, A Text book of Power System Engineering, Dhanpat Rai Publication.
2. Rai. G. D., Non Conventional Energy Sources, Khanna Publishers, Delhi, 2006.
3. Rao S., Parulekar B.B., Energy Technology-Non conventional, Renewable And Conventional, Khanna Publishers, Delhi, 2005.
4. Glynn Henry J., Gary W. Heinke, Environmental Science and Engineering, Pearson Education, Inc, 2004.
5. J. M. Fowler, Energy and the Environment, McGraw-Hill, 2 nd Edition, 1984.
6. Gilbert M. Masters, Introduction to Environmental Engineering and Science, 2nd Edition, Prentice Hall, 2003.

Basic Civil and Mechanical Engineering

Module 1: Introduction to civil engineering *4hrs*

Various Branches, role of civil engineer in various construction activities, basic engineering properties and uses of materials: earth, bricks, timber, stones, sand, aggregates, cement, mortar, concrete, steel, bitumen, glass, FRP, composite materials.

Module 2: Building Components & Building Planning *4hrs*

Foundation and superstructure, functions of foundation, types of shallow and deep foundations, suitability in different situation, plinth, walls, lintels, beams, columns, slabs, roofs, staircases, floors, doors, windows, sills, Study of Building plans, ventilation, basics of plumbing and sanitation

Module 3: Surveying *4hrs*

Principles of survey, elements of distance and angular measurements, plotting of area, base line and offsets, introduction to Plane table surveying, introduction to levelling, concept of bench marks, reduced level, contours

Part II Basic Mechanical Engineering

Unit 1: Introduction to Mechanical Engineering, Introduction to Laws of Thermodynamics with simple examples pertaining to respective branches, IC Engines: Classification, Applications, Basic terminology, 2 and 4 stroke IC engine working principle, Power Plant: Types of Power plant; Gas power plant, Thermal power plant, Nuclear power plant, Automobiles: Basic definitions and objectives [**4 hrs]**

Unit 2: Design Basics, Machine and Mechanisms, Factor of safety, Engineering Materials: types and applications, basics of Fasteners Machining and Machinability, Introduction to Lathe machine, Drilling machine, Milling machine, basics of machining processes such as turning, drilling and milling, Introduction to casting [**4 hrs]**

Text Books

- Anurag Kandya, “Elements of Civil Engineering”, Charotar Publishing, Anand
- M. G. Shah, C. M. Kale, and S. Y. Patki, “Building Drawing”, Tata McGraw Hill
- Sushil Kumar, “Building Construction”, Standard Publishers Distributors
- M. S. Palani Gamy, “Basic Civil Engineering”, Tata Mc-Graw Hill Publication
- Kanetkar T. P. and Kulkarni S. V., “Surveying and Levelling”, Vols. I, II and III, VidyarthiGruh Prakashan, Pune
- B. C. Punmia, “Surveying”, Vol.- I, Vol.-II, Vol.-III, Laxmi Publications
- G. K. Hiraskar, “Basic Civil Engineering”, Dhanpat Rai Publications
- Gopi Satheesh, “Basic Civil Engineering”, Pearson Education
- P. K. Nag “Engineering Thermodynamics”, Tata McGraw Hill, New Delhi 3rd ed. 2005
- A. Ghosh, A K Malik, “Theory of Mechanisms and Machines”, Affiliated East West Press Pvt. Ltd. New Delhi.

· Serope Kalpakaji and Steven R Schimd " Amanufacturing Engineering and Techology" Addision Wsley Laongman India 6th Edition 2009

· V. B. Bhandari, " Deisgn of Machine Elements", Tata McGraw Hill Publications, New Delhi.

Engineering Mathematics – II

Unit 1: Complex Numbers

Definition and geometrical representation ; De-Moivre's theorem(without proof) ; Roots of complex numbers by using De-Moivre's theorem ; Circular functions of complex variable – definition ; Hyperbolic functions ; Relations between circular and hyperbolic functions ; Real and imaginary parts of circular and hyperbolic functions ; Logarithm of Complex quantities.

[07 Hours]

Unit 2:Ordinary Differential Equations of First Order and First Degree and Their Applications

Linear equations; Reducible to linear equations (Bernoulli's equation); Exact differential equations; Equations reducible to exact equations ; Applications to orthogonal trajectories , mechanical systems and electrical systems. **[07 Hours]**

Unit 3: Linear Differential Equations with Constant Coefficients

Introductory remarks - complementary function, particular integral ; Rules for finding complementary functions and particular integrals ; Method of variation of parameters ; Cauchy's homogeneous and Legendre's linear equations. **[07 Hours]**

Unit 4: Fourier Series

Introductory remarks- Euler's formulae ; Conditions for Fourier series expansion - Dirichlet's conditions ; Functions having points of discontinuity ; Change of interval ; Odd and even functions

- expansions of odd and even periodic functions ; Half -range series. **[07 Hours]**

Unit 5: Vector Differential Calculus

General rules of vector Differentiation; Scalar and vector fields: Gradient , divergence and curl ; Solenoidal and irrotational vector fields; Vector identities . **[07 Hours]**

Unit 6: Vector Integral Calculus

Vector Integration : line integral , surface integral and volume integral ; Green's lemma , Gauss'divergence theorem and Stokes' theorem (without proofs) . **[07 Hours]**

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
3. A Course in Engineering Mathematics (Vol II) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan, Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. ,Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.

General Instructions:

1. The tutorial classes in Engineering Mathematics-II are to be conducted batchwise. Each class should be divided into three batches for the purpose.
2. The internal assessment of the students for 20 marks will be done based on assignments,surprise tests, quizzes, innovative approach to problem solving and percentage attendance.
3. The minimum number of assignments should be eight covering all topics.

ENGINEERING CHEMISTRY

Unit 1: Water Treatment *(6L)*

Introduction , hard and soft water, softening of water – Zeolite process, Ion exchange process, HotLime –Soda process, water characteristics- Hardness and its determination by EDTA method, Dissolve oxygen (DO) and its determination by Winkler's method.

Unit 2: Phase Rule *(7L)*

Phase Rule, statement, Explaination of the terms – Phase, Components, Degrees of freedom. Onecomponent system – Water and Sulphur. Reduced phase rule equation, Two components alloy system- Phase diagram of Silver- Lead alloy system.

Unit 3: Metallurgy *(6L)*

Introduction, Occurrence of metals, types of ores, concentration of ores by physical methods- Crushing and Sizing, Froth- Flotation, Magnetic Separation, Gravity separation method. Chemical methods- Calcination, Roasting, Reduction of Ore- by Pyrolysis, Chemical reductions, ElectrolyticRefining of Metals.

Unit 4: Fuels and Lubricants *(7L)*

Fuels: Introduction, classification of fuel, Calorific value of a fuel, characteristics of a good fuel, solid fuel- Coal , Various types of Coal, Analysis of coal- Proximate and Ultimate analysis, liquid fuel- Refining of Petroleum

Lubricants: Introduction, classification of lubricants - Solid, Semi –solid and Liquid Lubricants ,properties of lubricants ,Physical properties – Viscosity, Viscosity index, surface tension, Flash point and Fire point. Chemical properties – Acidity, Saponification.

Unit 5: Electrochemistry *(6L)*

Introduction - **Basic concepts**: Definition and units of Ohm's law, Specific resistance, SpecificConductance, Equivalent conductance, Molecular conductance, Method of conductance measurement by Wheatstone bridge method, Cell constant.

Debye- Huckel theory of strong electrolyte, Conductometric titrations, Ostwald's theory of acid-base indicator, Quinonoid theory, Glass electrode.

Text books:

1. Jain P.C & Jain Monica, Engineering Chemistry, Dhanpat Rai & Sons, Delhi, 1992.
2. Bhal & Tuli, Text book of Physical Chemistry (1995), S. Chand & Company, New Delhi.
3. O. G. Palanna , Engineering Chemistry, Tata McGraw-Hill Publication, New Delhi.
4. S. S. Dara, A textbook of Engineering Chemistry, McGraw-Hill Publication, New Delhi.

Reference books:

1. Barrow G.M., Physical Chemistry, McGraw-Hill Publication, New Delhi.
2. Shikha Agarwal, Engineering Chemistry- Fundamentals and applications, Cambridge Publishers - 2015.
3. WILEY, Engineering Chemistry, Wiley India, New Delhi 2014.
4. Atkins, Physical chemistry.

ENGINEERING CHEMISTRY Lab

List of Experiments: (Perform any 10 Experiments)

1. Determination of Hardness of water sample by EDTA method.
2. Determination of Chloride content in water sample by precipitation titration method.
3. Determination of Dissolve Oxygen in water by Iodometric method.
4. Determination of percent purity of Bleaching Powder.
5. pH – metric Titration (Acid Base titration)
6. Conducto-metric Titration (Acid Base titration)
7. Surface tension
8. Viscosity
9. To determine acidity water sample.
10. To determine calorific value of a fuel.
11. Determination of Acid value of an oil sample.
12. Determination of Saponification value of an oil sample.
13. Experiment on water treatment by using Ion exchange resins.
14. To find out P-T curve diagram of steam.
15. To determine alkalinity water sample.

Reference Books:

1. Systematic experiments in Chemistry, A. Sethi, New Age International Publication, New Delhi.
2. Practical Inorganic Chemistry, A. I. Vogel, ELBS Pub.
3. Practical in Engineering Chemistry, S. S. Dara.

Engineering Mechanics

Course Contents

Module1:Basic Concepts **(7 Lectures)**

Objectives of Engineering Analysis and Design, Idealization of Engineering Problems, Simplification of real 3D problems to 2-D and 1-D domain,Basis of Assumptions, types of supports, types of load, free body diagram, Laws of Motion, Fundamental principles, Resolution and composition of a forces, Resultant, couple, moment, Varignon's theorem, force systems, Centroid of composite shapes, moment of inertia of planer sectionsand radius of gyration

Module 2:Equilibrium ***(7 Lectures)***

Static equilibrium, analytical and graphical conditions of equilibrium, Lami's theorem, equilibrium ofcoplanar concurrent forces, coplanar non concurrent forces, parallel forces,beams reactionsSimple trusses(plane and space), method of joints for plane trusses, method of sections for plane trusses **Friction:**Coulomb law, friction angles, wedge friction, sliding friction and rolling resistance

Module3:Kinematics ***(7 Lectures)***

Types of motions, kinematics of particles, rectilinear motion, constant and variable acceleration, relative motion, motion under gravity, study of motion diagrams, angular motion, tangential and radial acceleration, projectile motion, kinematics of rigid bodies, concept of instantaneous center of rotation, concept of relative velocity,

Module4:Kinetics ***(6 Lectures)***

Mass moment of inertia, kinetics of particle, D'Alembert's principle:applications in linear motion, kinetics of rigid bodies, applications in translation, applications in fixed axis rotation

Module5: Work, Power, Energy ***(6 Lectures)***

Principle of virtual work, virtual displacements for particle and rigid bodies, work done by a force, spring, potential energy, kinetic energy of linear motion and rotation, work energy equation, conservation of energy, power, impulse momentum principle, collision of elastic bodies.

Text Books

- S. Timoshenko, D. H. Young, "Engineering Mechanics", McGraw Hill, 1995.
- Tayal A. K., "Engineering Mechanics", Umesh Publications, 2010.
- Bhavikatti S. S., Rajashekarappa K. G., "Engineering Mechanics", New Age International Publications, 2nd Edition.
- Beer, Johnston, "Vector Mechanics for Engineers", Vol. 1: Statics and Vol. 2: Dynamics, McGraw Hill Company Publication, 7th edition, 1995.
- Irving H. Shames, "Engineering Mechanics - Statics and Dynamics", Pearson Educations, Fourthedition, 2003.
- McLean, Nelson, "Engineering Mechanics", Schaum's outline series, McGraw Hill Book Company, N. Delhi, Publication.
- Singer F. L., "Engineering Mechanics - Statics & Dynamics", Harper and Row Pub. York.
- Khurmi R. S., "Engineering Mechanics", S. Chand Publications, N. Delhi

Engineering Mechanics Laboratory

Students are expected to satisfactorily complete any ten experiments listed below.

List of Practical's/Experiments/Assignments

1. Polygon law of coplanar forces.
2. Centroid of irregular shaped bodies.
3. Bell crank lever.
4. Support reaction for beam.
5. Problems on beam reaction by graphics statics method.
6. Simple / compound pendulum.
7. Inclined plane (to determine coefficient of friction).
8. Collision of elastic bodies (Law of conservation of momentum).
9. Moment of Inertia of fly wheel.
10. Verification of law of Machine using Screw jack
11. Verification of law of Machine using Worm and Worm Wheel
12. Verification of law of Machine using Single and Double Gear Crab.
13. Assignment based on graphics statics solutions
14. Application of Spreadsheet Program for conceptslike law of moments, beam reactions, problemsin kinematics, etc.
15. Any other innovative experiment relevant to Engineering Mechanics.

Computer Programming in C

Unit 1

Process of programming: Editing, Compiling, Error Checking, executing, testing and debugging of programs. IDE commands. Eclipse for C Program development, Flowcharts, Algorithms. **(4 Lectures)**

Unit 2

Types, Operators and Expressions: Variable names, Data types, sizes, constants, declarations, arithmetic operators, relational and logical operators, type conversions, increment and decrement operators, bitwise operators, assignment operators and expressions, conditional expressions precedence and order of evaluation. **(4 Lectures)**

Unit 3

Control Flow: Statements and Blocks. If-else, else-if switch Loops while and for, do-while break and continue goto and Labels. Functions and Program Structure: Basic of functions, functions returning non- integers external variables scope rules. **4 Lectures)**

Unit 4

Arrays in C: Initializing arrays, Initializing character arrays ,multidimensional arrays. **(4 Lectures)**

Unit 5

Structures C: Basics of structures, structures and functions arrays of structures, **(4 Lectures)**

Pointer in C. Pointers to integers, characters, floats, arrays, structures.

Special Note: <u>Topic of Pointers in C</u> is only for lab exercises and not for end semester examinations.

Reference/Text Books:

1. Brain W. Kernighan & Dennis Ritchie, The C Programming Language, Prentice Hall, 2 nd Edition, 1988.
2. R. S. Bichkar, Programming with C, Orient Blackswan, 1 st Edition, 2012.
3. Herbert Schildit, C the Complete Reference, McGraw-Hill Publication, 2000.
4. Balguruswamy, Programming in C, PHI.
5. Yashwant Kanitkar, Let Us C, PHI

Computer Programming in C: Laboratory

List of Practical:

1. Assignment on Flow Chart.
2. A Simple program to display a message “Hello world” on screen.
3. A Program to take input from user and display value entered by user on screen.
4. Basic example for performing different C Operations using operator. (With and withoutusing scanf()).
5. Basic Program on Operator. (Using scanf()).

a) Program to find and print area, perimeter and volume of geometric objects.

b) Program to check a number entered by user is Perfect number or not.

6. Program to find maximum and minimum between two numbers given by user using if-elseand conditional Operators.
7. Program to swap two numbers.
8. Program to print square and factorial of an entered number using while loop.
9. Program to check a number is Palindrome number or not.
10. Program to check Armstrong number.
11. Program to check and generate prime numbers up to n.
12. Program to find GCD of two entered numbers.
13. Program to find maximum and minimum from n entered numbers.
14. Program to print alternate numbers from n entered numbers.
15. Program to search an element in an Array using linear and binary search.
16. Program to print entered numbers in ascending order using sorting.
17. Program to print addition, subtraction and multiplication of Matrices.
18. Program to find length of string. (With and without using library function).
19. Programs demonstrating use of Structures, Arrays of Structures and Structure containingarrays.
20. Programs demosntrating use of pointers to integers, floats, char, strings, structures and arrays.

ESC-105 Basic Electrical and Electronics Engineering

Unit 1 *(4 Lectures)*

Elementary Electrical Concepts:
Fundamental of Electrical system Potential difference, Ohm's law, Effect of temperature on resister, resistance temperature coefficient, Electrical wiring system: Study of different wire gauges and their applications in domestic and industry. Energy Resources and Utilization: Conventional and nonconventional energy resources; Introduction to electrical energy generation from different resources, transmission, distribution and utilization, Advantages & Disadvantages of AC & DC transmission. Concept of Supply Demand, Power Factor, Need of unity factor.

Unit 2 *(4 Lectures)*

Measurement of Electrical Quantities:
Measurement of Voltage, Current, and Power; Measurement of 3 phase power; Study of Energy meters. Study of Electrical Storage devices: Batteries such as Nickel-cadmium (NiCd), Lithium- ion (Li-ion), Lithium Polymer (Li-pol.) batteries. Study of circuit breakers & Actuators (MCB & MPCB, Power Contactors & Aux contactors, Electro-Mechanical & Solid state Relays)

Unit 3 *(4 Lectures)*

Diodes and Circuits:
The P-N Junction Diode, V-I characteristics, Diode as Rectifier, specifications of Rectifier Diodes, Half Wave, Full wave, Bridge rectifiers, Equations for I_{DC} V_{DC} V_{RMS}, I_{RMS}, Efficiency and Ripple Factor for each configuration. Filters: Capacitor Filter, Choke Input Filter, Capacitor Input Filter(Π Filter), Zener Diode, Characteristics, Specifications, Zener Voltage Regulator, Types of Diodes: LED, Photodiode

Unit 4 *(4 Lectures)*

Semiconductor Devices and Applications:
Transistors: Introduction, Classification, CE, CB, and CC configurations, α, β, concept of gain and bandwidth. Operation of BJT in cut-off, saturation and active regions (DC analysis). BJT as an amplifier, biasing techniques of BJT, BJT as a switch.
Introduction to Digital Electronics: Number System, Basic logic Gates, Universal Gates, Boolean Postulates, De-Morgan Theorems

Reference/Text Books:

1. V. N. Mittal and Arvind Mittal, Basic Electrical Engineering, McGraw-Hill Publication.
2. Brijesh Iyer and S. L. Nalbalwar, A Text book of Basic Electronics, Synergy Knowledgeware Mumbai, 2017. ISBN:978-93-8335-246-3
3. Vincent DelToro, Electrical engineering Fundamentals, PHI Publication, 2nd Edition, 2011.
4. Boylstad, Electronics Devices and Circuits Theory, Pearson Education.
5. Edward Hughes, Electrical Technology, Pearson Education.
6. D. P. Kothari and Nagrath, Theory and Problems in Electrical Engineering, PHI Publication, 2011.
7. B. L. Theraja, Basic Electronics, S. Chand Limited, 2007.
8. Millman Halkias, Integrated Electronics-Analog and Digital Circuits and Systems, McGraw-Hill Publication, 2000.
9. Donald Neaman, Electronic Circuit Analysis and Design, McGraw-Hill Publication, 3rd Edition.
10. Donald Neaman, Electronic Circuit Analysis and Design, McGraw-Hill Publication, 3rd Edition.
11. Printed Circuit Boards Design & Technology, Walter C. Bosshart, McGraw-Hill Publication.

Note: Students are advised to use internet resources whenever required

Workshop Practices

Instructions to the student:

Each student is required to maintain a „workshop diary" consisting of drawing / sketches of the jobsand a brief description of tools, equipment, and procedure used for doing the job.

List of Practical:

1. Wood sizing exercises in planning, marking, sawing, chiseling and grooving to make half lap joint andcross lap joint.

2. A job involving cutting, filing to saw cut, filing all sides and faces, corner rounding, drilling andtapping on M. S. plates.

3. A job on use of plumbing tools and preparation of plumbing line involving fixing of water tap and useof elbow, tee, union and coupling, etc.

4. Making a small parts using GI sheet involving development, marking, cutting, bending, brazing andsoldering operations- i)Tray ii) Funnel and similar articles.

5. Exercise in Arc welding (MMAW) to make a square butt joint.

6. Exercise in Resistance (Spot) welding to make a lap joint.

7. A job using power operated tools related to sheet metal work, Welding, Fitting, Plumbing, Carpentryand pattern making.

8. A job on turning of a Mild Steel cylindrical job using center lathe.

Contents:

a) **Carpentry:** Technical Terms related to wood working, Types of wood, Joining materials, Types of joints - Mortise and Tenon, Dovetail, Half Lap, etc., Methods of preparation and applications, Wood working lathe, safety precautions.

b) **Welding:** Arc welding - welding joints, edge preparation, welding tools and equipment, Gas welding - types of flames, tools and equipment, Resistance welding - Spot welding, joint preparation, tools and equipment, safety precautions.

c) **Fitting and Plumbing:** Fitting operation like chipping, filing, right angle, marking, drilling, tapping etc., Fitting hand tools like vices, cold chisel, etc. Drilling machine and its operation, Different types of pipes, joints, taps, fixtures and accessories used in plumbing, safety precautions.

d) **Sheet Metal Work:** Simple development and cutting, bending, Beading, Flanging, Lancing and shearing of sheet metal, Sheet metal machines - Bending Machine, Guillotine shear, Sheet metal joints, Fluxes and their use.

e) **Machine shop**: Lathe machine, types of lathes, major parts, cutting tool, turning operations, safety precautions

Reference/Text Books:

1. K. C. John, Mechanical Workshop Practice, Prentice Hall Publication, New Delhi, 2010.

2. Hazra and Chaudhary, Workshop Technology-I, Media promoters & Publisher privatelimited.

SEMESTER -III

BTBC301	BSC7	**Subject name** **Engineering Mathematics-III**	**L-T-P** **3-1-0**	**4 Credits**

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	**Laplace Transform [07 Hours]** Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by tn, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.
UNIT- 2	**Inverse Laplace Transform [07 Hours]** Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding Inverse Laplace transforms; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.
UNIT- 3	**Fourier Transform [07 Hours]** Definitions – integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Complex form of Fourier integrals ; Fourier sine and cosine transforms ; Properties of Fourier transforms ; Parseval's identity for Fourier Transforms.
UNIT- 4	**Partial Differential Equations and Their Applications [07 Hours]** Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variable2 s – applications to find solutions of one dimensional heat flow equation (i.e. Laplace $\left(\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}\right)$, and two dimensional heat flow equation (i.e. Laplace equation : $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$).
UNIT- 5	**Functions of Complex Variables (Differential calculus)[07 Hours**]

	Limit and continuity of f(z); Derivative of f(z) ; Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Mapping: Translation, magnification and rotation, inversion and reflection , bilinear transformation; Conformal mapping.
UNIT- 6	**Functions of Complex Variables (Integral calculus)[07 Hours]** Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).

Text Books:

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
3. A Course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune VidyarthiGrihaPrakashan, Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. RajnishVerma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books:

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd., Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.
4. Integral Transforms and Their Engineering Applications by Dr. B. B. Singh, Synergy. Knowledge ware, Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill, New York.

General Instructions:

1. The tutorial classes in Engineering Mathematics-III are to be conducted batch-wise. Each class should be divided into three batches for the purpose.
2. The Continuous Assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.
3. The minimum number of assignments should be eight covering all topics.

Course Outcomes: On completion of the course, student will be able to formulate and solve mathematical model of Food engineering & Technology phenomena in field of structures, survey, fluid mechanics and operation.

BTFT302		Subject name FLOW FLUID	L-T-P 3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	*Fluid Statics*: Normal forces in fluids, Pressure Measurements, Forces on Submerged bodies, Buoyancy and Stability.
UNIT- 2	*Fluid Properties*: Newtonian and non-Newtonian Fluids, Nature of Turbulence, Eddy Viscosity, Flow in Boundary Layers, Basic Equation of Fluid Flow, Bernoulli's Equation, Navier stokes equation.
UNIT- 3	*Flow of Incompressible Fluids*: Laminar and Turbulent flow in pipes, Velocity Distribution in Pipes, Frictional Losses in Pipes and Fittings, Fanning equation, Estimation of economic pipe diameter. Derivation of HAGEN-POISEULLI and f=16/Re equations.
UNIT- 4	*Dimensional analysis* and its Applications to Fluid Flow. *Flow of compressible fluids*: Compressible flow and flow through nozzles.
UNIT- 5	*Flow Measurements*: Pilot tube, Orifice, Venturi, Rotameter and Notches, wet gas metre etc.
UNIT- 6	*Fluid Machinery*: Classification and Performance of Pumps, Turbines, Compressors, and Blowers,Selection and Specification, Net positive Suction Head.

Books Recommended:	
	Mc Cabe, W.L. andSmith, J.C. : Unit Operation of Chemical Engineering, McGraw Hill.
	Fox, R.W. and McDonald, A.T. : Introduction of Fluid Mechanics (SI Version) 4^{th} ed. John Wiley and Sons, 1996.
	Coulson, J.M. and Richardson, J.F. : Chemical Engineering, Vol. I, Pergamon
	Foust, A.S., Wensel, L.A., Clump, C.W., Maus, L. and Anderson L. : Principles of Unit Operations, John Wiley.
	Badger, W.L. and Banchero, J.T. : Introduction to Chemical Engineering, Tata McGraw Hill Pub. Co. Ltd., 1997.
	Chattopadhya, P. : Unit Operations of Chemical Engineering, Vol. I, Khanna Publishers, Delhi, 1997.

BTFT304		Subject name Element of Bio & Food Science	L-T-P 3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Introduction to Biology and its branches. Prokaroytic and Eukaryotic cells. Cells: Animal and Plant cell structures, organelles and their functions. Cell division and cell cycle. Histology : Plant and Animal tissues, Muscles in animals. Photosynthesis of Plants. Digestion of foods in animals. Organisms and their environments – Ecosystems. Growth and development in plants and animals. Relevance of Microbiology in preservation of foods. Composition of microbial world. Branches of Microbiology. Microscopes and their application in Microbiology.
UNIT- 2	Morphology and physiology of virus, bacteria, yeast, molds and algae. Growth, nutrition and reproduction. Isolation and identification of microorganisms. Pure cultures and their characteristics. Sterilization. Maintenance of cultures. Culturing techniques: Batch culturing, Continuous culturing, Fed-batch culturing. Factors affecting growth. Generation of energy and its uses in biosynthesis. General principles of bacterial genetics, DNA as genetic material, Mutations and their

	Chemical basis, recombinant DNA technology. Strain improvement by mutations, recombinant DNA technology - Application of recombinant DNA technology, recombinant products available in the market, in pipeline and at laboratory scale.
UNIT- 3	Microorganisms and environment: Microorganisms and environment, Water Microbiology. Management of toxic industrial wastes. - Physical and chemical methods of control of microorganisms. Microbial integrations. Food industry waste as fermentation substrate.
UNIT- 4	Definition of food, food science, and food technology. Professional bodies both in India and abroad dealing with food technology. General introduction of food preservation. Historical developments. Contamination of foods by microorganisms from natural sources, spoilage of different foods – general principles, causes and spoilage and growth of microorganisms in foods. Food intoxicants, mycotoxins.
UNIT- 5	food poisoning and food infections-investigation of a food borne disease outbreak. Contamination, Food containers: rigid and flexible: glass, metal, plastic, packaging system characteristics and advantages. Charactersitics of plant and animal foods. Causes of food spoilage and methods of prevention. Preservation of foods by: pasteurization, sterilization, drying, radiation, refrigeration, freezing, sugar, salt, chemicals, radiation, microorganisms. Intermediate moisture foods. Fortification and enrichment of foods.
UNIT- 6	Recent trends in food processing and preservation: Introduction to high pressure processing, Hurdle technology, Ohmic heating etc. General principles of food hygiene in food handling, personnels, food processing plants. Impurities in water and its treatment. Sanitation facities and procedures in food processing plants. Application of mathematical techniques to describe food processing operations such as drying, degradation of nutrients and pigments during processing and storage. Use of semi-log and log-log paper.

BOOKS RECOMMENDED:		
1.	Potter, N.N	: Food Science, CBS publication, New Delhi, 2005
2.	Desrosier and Desrosier	Tecnology of food Preservation . CBS publication, New Delhi, 2009.
3.	Frazier	: Food Microbiology, Tata McGraw Hill, New Delhi

5) Food Processing Lab 01

Subject Code – BTFT105	**Food Processing Lab 01**	Max. Marks 100 Credits : 2
Sr .No	**Name of Experiment**	

1	General study of pipe fittings, valves and other equipments in the unit operations laboratory.
2	Pressure drop for flow through pipelines, valves & fittings.
3	Characteristics of pumps.
4	Flow measurement by the use of orifice meter, venturimeter, rotameter & pitot tube.
5	Flow over weirs and notches.
6	Flow measurement of compressible fluids.

6) Food Processing Lab 02

Subject Code – BTFT106	**Food Processing Lab 02**	Max. Marks 100 Credits : 2
Sr .No	**Name of Experiment**	
1	Use of microscopic technique for identification of microorganisms on the basis of cell morphology and specific staining technique.	
2	Isolation of pure cultures of bacteria, yeasts, moulds and taxonomic identification on the basis of morphology and physiology.	
3	Preparation of nutrient broth and media with agar, gelatin and specific media for culture of microorganisms.	
4	Microorganisms are Ubiquitous and concept of aseptic conditions while cooking Gram's Staining Dilution's, pour plating, spread plating, streaking. Media preparation & strelization.	
5	Microbial growth determination by - O.D. and Viable Counting.	
6	Phenol-Coefficient: Concept and Determination of those of germicides available in market.	
7	Microbiological assay of water. Enzyme production and assay.	
8	Measurement of activity of anti-microbial agents for the control of microorganisms in foods.	

7) Food Processing Lab 03

Subject Code – BTFT307	**Food Processing Lab 03**	Max. Marks 100 Credits : 1
Sr .No	**Name of Experiment**	

1	Lab – Safety
2	Preparation of Benzamide & Aspirin-Purification
3	determination of melting point and percentage yield.
4	Identification of unknown organic compounds – Hydrocarbons, Phenols, Aldehydes
5	Identification of unknown organic compounds, Ketones, Carboxylic acids, Amides and Amines.
6	Identification of unknown organic compounds Amides and Amines.

Subject Code – BTFT308	**Internship-I Evaluation**	Max. Marks 100 Credits : 1

FOURTH SEMESTER

BTFT401	**Subject name** **Human Rights Management**	**L-T-P** **3-1-0**	**3 Credits**

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	**The Basic Concepts:** Individual, group, civil society, state, equality, justice.Human Values, Human rights and Human Duties: Origin, Contribution of American bill of rights, French revolution. Declaration of independence, Rights of citizen, Rights of working and exploited people[4 hrs]
UNIT- 2	**Fundamental rights and economic program:** Society, religion, culture, and their inter-relationship. Impact of social structure on human behavior, Social Structure and Social Problems: Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labour.[4 hrs]
UNIT- 3	**Workers and Human Rights:** Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy.[4 hrs]
UNIT- 4	**NGOs and human rights in India:** Land, Water, Forest issues.[4 hrs]
UNIT- 5	Human rights in Indian constitution and law i) The constitution of India: Preamble
	ii) Fundamental rights. iii) Directive principles of state policy. iv) Fundamental duties. v) Some other provisions.[4 hrs]
UNIT- 6	**Universal declaration of** human rights and provisions of India. Constitution and law.National human rights commission and state human rights commission.[4 hrs]

BOOKS RECOMMENDED:	
1.	Shastry, T. S. N., "India and Human rights: Reflections", Concept Publishing Company India (P Ltd.), 2005.
2.	C.J. Nirmal, "Human Rights in India: Historical, Social and Political Perspectives(Law in India)", Oxford India.

BTFT401	**BSC7**	Subject name PROCESS PLANT MATERIAL AND ENERGY BALANCE	**L-T-P** **3-1-0**	**4 Credits**

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Review: Stoichiometric and composition relationship
UNIT- 2	Gas laws; Gaseous mixtures, vapor pressure, humidity, etc.
UNIT- 3	Material Balances for Non-reaction systems including balances involving recycle and by-pass streams.
UNIT- 4	Material Balances for Reacting systems including balances involving recycle and purge streams.
UNIT- 5	Combustion Calculations.
UNIT- 6	Energy balances on nonreactive and reactive systems

BOOKS RECOMMENDED:

1.	Bhatt, V. I. & Vora, S. M.	Stiochiometry, 3rd Edition, Tata McGraw Hill, 1984.
2.	Himmelbleau, D. M.	Basic Principles and Calculations in Chemical Engineering, 6th Edition, Prentice Hall, 1977.
3.	Felder, R. M. & Rousseau R.W.	Elementary Principles of Chemical Processes, 3rd Edition, John Wiley and Sons, 1986.
4.	Reklaithis, G. V.	Introduction of Material and Energy balances, John Wiley, 1983.

5.	Lubyben, L.W. & Winzel, L. A.	Chemical Process Analysis, 2nd Edition, Prentice Hall, 1988.

BTFT402	**BSC7**	Subject name CHEMICAL ENGINEERING THERMODYNAMICS	**L-T-P** **3-1-0**	**4 Credits**

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Brief review of the terms: state functions, types of systems, internal energy, heat and work and reversible and irreversible processes. First Law of Thermodynamics and its Engineering Applications i.e. constant volume processes, constant pressure processes, isothermal and adiabatic processes, pumps, turbines, compressors, nozzles, heat exchangers, pitot tube, venturimeter and orifice meter. Throttling Processes, Joule-Thomson Coefficient, liquefication of gases
UNIT- 2	Thermochemistry includes a brief review of heat capacities and their measurement, standard heat of reaction, standard heat of formation, standard heat of combustion, flame temperature, H-x diagrams, heat of solution, partial, molar enthalpies, enthalpy for phase change etc. Equation of state for real gases and their mixtures. Principle of corresponding states and generalized compressibility factor.
UNIT- 3	Review of Second law of thermodynamics, entropy concept, Entropy and lost work calculations. Microscopic interpretation of entropy. Third Law of thermodynamics and its applications. Free energy functions and their significance in phase and chemical equilibria, Clapeyron's equation and some important correlations for estimating vapor pressures. Estimation of thermodynamic properties by using graphs and tables.
UNIT- 4	Phase Equilibria: Partial molar properties, partial molar Gibbs free energy, Chemical potential and its dependence on temperature and pressure Ideal solutions (Lewis-Randel Rule). Fugacity and its calculations. Dependence of fugacity of temperatures and pressure
UNIT- 5	Solution behaviour of real liquids and solids. Activity and activity coefficients. Variation of activity co-efficient with temperature and composition. Activity coefficients of electrolytes standard states. Properties of mixing. Excess Properties, Gibbs-Duhem equation and its application to vapour-liquid equilibria.
UNIT- 6	Chemical Equilibria: Equilibrium constant in terms of measurable properties variations of equilibrium constant with temperature and pressure. Adiabatic reactions, Gibbs phase rule, equilibria in heterogeneous reactions.

***Books Recommended*:**

1.	Smith, J.M., Van Ness, H.C. and Abbott, M.M.	Introduction to Chemical Engineering Thermodynamics, 7^{th} Edition, McGraw Hill Professional, 2005
2.	Elliott, J.R and Lira, C.T.	Introductory Chemical Engineering Thermodynamic, Prentice Hall PTR., 1999.
3.	Rao, Y.V.C.	Chemical Engg. Thermodynamics, Orient Blackswan,1997.
4.	Dodge, B.F.	Chemical Engg. Thermodynamics, McGraw Hill, 1944, Original from the University of Michigan, 2007.
5.	Narayanan, K.V.	A Textbook of Chemical Engineering Thermodynamics, PHI Learning Pvt. Ltd., 2004.

BTFT403		**Subject name** **Food Chemistry**	**L-T-P** **3-0-0**	**3 Credits**
Teaching Scheme:		Examination Scheme:		
Lecture: 3 hrs./week		Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)		

Course Contents

UNIT- 1	Moisture in foods : Hydrogen bonding, bound water, water activity.
UNIT- 2	Carbohydrates: Definition, classification and nomenclature. General properties(physical and chemical) of sugar. Reducing and non-reducing sugars. Common monosaccharides, di-saccharides and poly-saccharides. Chemistry of starch, cellulose, gums and mucilage. Crude fibre.
UNIT- 3	Protein: Classification. Amino acid sequence in proteins, pleated sheet and helix structure of proteins. Molecular weight of proteins and ultra-centrifuge separation and purification of proteins. Physical and chemical properties of amino acids.Chromatographic separation of amino acids. Food proteins and their characteristics. Protein denaturation.
UNIT- 4	*Lipids : Classification.* Occurance in foods and composition, identification of natural fats and oils in foods. Physical (melting point, softening point, slipping point, short melting point, specific gravity, refractive index, smoke-flash and fire point, turbidity point) and chemical properties. Flavor changes in fats and oils.
UNIT- 5	Natural pigments and Flavouring Agents: Chlorophylls, carotenoids, anthocyanins, anthoxanthins, flavonoids, tanninsandnatural flavour constituents. Saponins, Alkaloids. Pectic substances-Protopectin, pectin gels, Importance of Pectin in food products.

UNIT- 6	*Vitamins:* Occurance and chemistry of various vitamins: A, B, C, D, E, K. ,Losses during processing and storage.*Food Additives:* Types; Methods for safety levelanalysis, color additives legislation.

Recommended Books.

1 L.H. Meyer, C.B.S. Publishers, Delhi, 1987 : Food Chemistry
2 Fenamma : Food chemistry
3 de Man: Food Chemistry

BTFT404		**Subject name** **Food Microbiology**	**L-T-P** **3-1-0**	**4 Credits**
Teaching Scheme:		Examination Scheme:		
Lecture: 3 hrs./week Tutorial: 1 hrs./week		Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)		
Course Contents				
UNIT- 1	Contamination of foods by microorganisms from natural sources, spoilage of different foods: general principles, causes and spoilage and growth of microorganisms in foods Preservation of foods by different preservation methods, contamination, preservation and spoilage of different food products..			
UNIT- 2	Food poisoning and food infections – investigation of food borne disease outbreak. Microbiology of individual food products.			
UNIT- 3	Dairy products, bread etc			
UNIT- 4	Food from microbes: Fermented foods. Microbial flavour – fragrances.			
UNIT- 5	Food Allergies. Antimicrobial agents used in foods. Rapid methods for microbiological analysis of foods			
UNIT- 6	Food processing plant, hygiene and sanitation: Importance of hygiene and sanitation. Chemicals and methods used in sanitation of plant and equipments			

BOOKS RECOMMENDED:	
1.	Prescott, Herley, Klein : Microbiology, 2nd Edition, Tata McGraw Hill.

2.	Stain : General Microbiology.
3.	Salley : Bacteriology, Tata McGraw Hill.
4.	Prescott & Dunn : Industrial Microbiology, CBS Publishers.
5.	Casida : Industrial Microbiology, John Wiley.
6.	Pelczar : Microbiology, Tata McGraw Hill.
7.	Frazier : Food Microbiology, Tata McGraw Hill, India.

Elective I

BTBC405A	**BSC7**	**Subject name** **STRENGTH OF MATERIALS**	**L-T-P** **3-1-0**	**3 Credits**
Teaching Scheme:			Examination Scheme:	
Lecture: 3 hrs./week Tutorial: 1 hrs./week			Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)	

Course Contents

UNIT- 1	*Stresses and Strains*: *Concept of simple stress and simple strain,* mechanical properties of solids, types of load, Tensile stress , compressive stress, shear stress, complementary shear stress, thermal stresses, tensile test , stress strain curve , Hooke's law, modulus of elasticity, modulus of rigidity, Principle of St. Venant strain, factor of safety, compound bars, , Compound Stresses and Compound Strains in two-dimensional stress system , Stresses on oblique plane due to pure shear, principle planes and principle stresses, maximum shear stress, Mohr's circle of stress, Poisson's ratio, volumetric strain, elastic constants and relations between them.
UNIT- 2	*Shearing Force and Bending Moments in Beams*: Shearing force, bending moment, types of beams, types of load on beams, types of supports, sign- conventions for shearing force and bending moment, point of inflection , relations between bending moment and shearing force shearing force and bending moment diagrams for beam under different loads. Concentrated loads, uniformly distributed loads, numerical problems.
UNIT- 3	*Bending Stresses and Shearing Stresses in Beams*: Pure bending, graphical determination of moments of inertia, bending stress, composite beams, reinforced concrete beams, General eccentric loading, combined direct and bending stresses, eccentric longitudinal loads , Shear stress distribution in rectangular section and circular section, numerical problems. *Deflection of Beam*: Introduction, Macauly's integration method, simply supported beam with load at mid span and beam with eccentric load, moment area method, deflection due to shear, numerical problems.

UNIT- 4	Torsion of Shafts: Torsion of thin circular shaft, composite shaft, combined bending and torsion. equivalent torque, equivalent bending moment, numerical problems. Struts and Columns: Definition of strut and column, Euler's Column theory and assumptions made, Strut with both ends pinned, strut with one end fixed and one end free, strut with both ends

	free, Slenderness ratio, limitations of Euler theory, Rankine's Empirical formula, strut with eccentric loading, numerical problems.
UNIT- 5	Stresses and Strains in Thin Shells: Thin cylinder under internal pressure, thin spherical shell under internal pressure, volumetric strain, modifications for built-up shells, numerical problems.
UNIT- 6	Stresses and Strains in Springs: Types of Springs, stresses in Close coiled helical springs, open coiled helical springs, leaf springs, springs in parallel and in series, numerical problems. Strain Energy and Theories of Elastic Failure: Strain energy and resilience, Strain energy in tension and compression due to suddenly applied load and impact loads, strain energy due to shear, strain energy due to bending, strain energy due to torsion, theories of elastic failure and their graphical representation, numerical problems.

BOOKS RECOMMENDED:

1.	Ryder, G. H.: Strength of Materials, 3rd Edition S.I. Units Macmillan 1969.
2.	Bedi, D. S. : Strength of Materials, 6th Edition Khana Boo Publishing Co. (P)Ltd
3.	Timoshenko, S.: Strength of Materials Part-I, 3rd Edition, Cbs Publishers 1986.
4.	Singal & Sharma : Strength of Materials , Modern Publisher.

BTFT405B	**BSC7**	**Subject name** **MECHANICAL OPERATIONS**	**L-T-P** **3-1-0**	**3 Credits**

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	*Size Reduction*: Crushers and Grinders: jaw crusher, crushing rolls, Gyratory Crusher Tumbling/revolving mills, hammer Mill and Fluid energy mill. Closed and open circuits grinding. Power requirements. Laws of crushing.
UNIT- 2	*Mechanical Separation*: Screening: Stationery screens, Grizzlies, Trommel and Vibrating screens. International Standard Screens & Indian Standard Screens. Screening Analysis- differential and cumulative.
UNIT- 3	Motion of particle through a fluid: Stoke's Newton's law. Free and hindered setting. • Setting tank and double cone classifiers • Batch and continuous thickeners Settling chamber, cyclone, filter bag and electrostatic precipitators.

UNIT- 4	*Filtration*: Plate and frame filter press, continuous rotary vacuum filter, filter aids, theory of filtration for non-compressible cakes.
UNIT- 5	*Centrifugation*: Tubular bowl centrifuge, disk centrifuge and batch basket centrifuge. *Fluidization*: Conditions for fluidization: Aggregate and particulate fluidization. Ergun's and Carman-Kozeny equations.
UNIT- 6	*Mixing and Agitation*: Basic ideas and characteristics of mixing equipment power consumptions scale-up. *Conveying*: Mechanical and pneumatic conveying systems, storage & handling of materials.

BOOKS RECOMMENDED:	
1.	Mc Cabe, Warren L., Smith, Juluain C. and Harroit, Peter ; Unit Operations of Chemical Engineering, 5th Edition, Mc Graw Hill Int. ed (Chemical Engineering Series) Mc Graw Hill Book Company, New York, 1993.
2.	Foust, Alan S., Wenseli, Leonard A., Clump, Curtis W., mans, Louis and Anersen, L.Bryce ; : Principles of Unit Operations, Wiley International Edition, John Wiley & Sons Inc., New York.
3.	Coulson, J.M. and Richardson, J.F. ; Unit Operations (Volume 2 of Chemical Engineering) New York: Mc Graw – Hill Book Co;, Inc.
4.	Gupta, Santosh K. ; Momentum Transfer Operations, Tata McGraw-Hill, New Delhi.
5.	Badger, Walter L. and Banchero, Julius T.: : Introduction to Chemical Engineering, Mc Graw-Hill, Kogakusha Ltd., New Delhi.
6.	Brown, C.G.: Unit Operations, John Wiley & Sons, Inc., New York.
7.	Chattopadhyay, P. : Unit Operations of Chemical Engineering, Vol. I, Khanna Publishers, New Delhi.

BTFT405C		**Subject name** **Numerical Methods in Chemical Engineering**	**L-T-P** **3-1-0**	**3 Credits**

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Errors in Numerical Calculations, Solution of Algebratic and Transcendental Equations: The Bisection Method, The method of False Position, The Iteration Method, Newton-Raphson Method.
UNIT- 2	Interpolation: Finite Differences, Differences of a Polynomial, Newton's Formulae for Interpolation, Central Difference Interpolation Formulae, Interpolation with Unevenly Spaced Points, Divided Differences and their Properties, Inverse Interpolation, Curve Fitting, Least-Squares Curve Fitting Procedures, Weighted Least Squares Approximation.

UNIT- 3	Numerical Differentiation and Integration: Trapezoidal Rule, Simpson's 1/3 –Rule, Simpson's 3/8-Rule, Weddle's Rules and Romberg Integration.
UNIT- 4	Solution of Linear Systems, Gaussian Elimination Method, Gauss-Jordan Method, Jacobi Iteration Method, Gauss-Seidel Iteration Method.
UNIT- 5	Numerical Solution of Ordinary Differential Equation: Taylor's Series Expansion Method, Picard's Method, Euler's Method, Runga-Kutta Methods, Predictor-Corrector Methods, Simultaneous and Higher Order Equations.
UNIT- 6	Numerical Solution of Partial Differential Equations: Finite-Difference Approximation to Laplace's Equation, Parabolic Equations and Hyperbolic Equations

BOOKS RECOMMENDED:	
1.	Hildebrand, F.B. : Introduction to Numerical Analysis.
2.	Scarborough, J.B. : Numerical Mathematical Analysis, Oxford and ISH Pub.Co.
3.	Chopra, S.C.,& Canale, R.P.: Numerical Methods for Engineers.
4.	Sastry, S. S. : Introductory Methods of Numerical Analysis, 4th Edition, Prentice Hall

BTFT405D	**(BTHMC3401)**	Subject name **Organic chemistry**	**L-T-P** **3-1-0**	**4 Credits**

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	*Classification of organic compounds*: IUPAC nomenclature, Structural isomerism, Cis-trans isomerism. Shapes and Molecular orbital structures of compounds containing C, N and O. Conformations of alkanes. Organic reagents and reaction intermediates structures of dienes,
UNIT- 2	Organic reagents and reaction intermediates structures of pyridine, pyrrole, aromatic compounds. Optical isomerism, Chirality and optical activity; Enantiomers, Diastereomers, Meso-and Racemic compounds, Resolution of racemic mixture.*Asymmetric synthesis, Walden Inversion, Configuration (D and L nomenclature), Absolute con figuration (R and S nomenclature)*

UNIT- 3	*Chemistry of hydrocarbons: House synthesis, halogenation of alkanes, free radical mechanism, orientation, reactivity and selectivity. Cracking effect of structure on physical properties of compounds. Alkenes, catalytic hydrogenation, dehydration of alcohols, dehydrohalogenation, Saytzeff rule, electrophillic addition reactions, peroxide effect, mechanism of allylic substitution, acidity of 1-alkynes, conjugated dienes, 1,2- and 1,4- additions, free radical and ionic mechanisms of addition polymerisation reactions, ring- opening reactions of cyclopropane and cyclobutane, chemistry of benzene and alkylbenzenes,aromatic electrophillic substitution reactions,Friedel-Crafts reactions*
UNIT- 4	*Delocalisation: Concept of aromaticity, stability of cycloalkanes, resonance concept, inductive and mesomeric effects, directive effects, activating and deactivating groups. Hydrogen-bonding.*
UNIT- 5	Chemistry of functional groups: Alkyl and aryl halides, nucleophilic substitution, synthetic utility of Grignard reagents and alkyllithiums, mechanism of Grignard reactions of alcohols, benzylalcohol, acidity of phenols epoxy compounds, .
UNIT- 6	Anisole nucleophilic addition, benzaldehyde, acetophene, benzophenone, aldol condensation acidity of acids, alkyl and aryl amines. Synthetic utility of diazonium salts, basicity of amines, multistep synthesis

Books Recommended:

1	Bahl, B. S. & Bahl, Arun : Text-book of Organic Chemistry, 16th Edition, S. Chand and Company Ltd., New Delhi.
2	Solomons, T. W. G. : Fundamentals of Organic Chemistry, John Wiley and Sons, Inc., New York, 1994.
3	Morrison & Boyd : Organic Chemistry, Pearson education, 6th edition, 2007.
4	F.A.Carey: Organic Chemistry, Tata McGraw Hill, 7th edition, 2008.
5	Mukherji & Singh: Reaction mechanism in organic chemistry, Macmillan India Ltd.,

6) Food Processing Lab 04

Subject Code – BTFT406	**Food Processing Lab 04**	Max. Marks 100 Credits : 2

Sr .No	**Name of Experiment**
1	Preparation of samples for analyses. Determination of moisture content (wet basis and dry basis). Ash: total, acid soluble,.
2	Determination of moisture content (wet basis and dry basis). alkali soluble and water soluble
3	Determination of moisture content (wet basis and dry basis). Lipids, protein, crude fibre
4	Determination of moisture content (wet basis and dry basis). reducing and non-reducing sugar.
5	Determination of moisture content (wet basis and dry basis). vitamin-A,
6	Estimation of ascorbic acid,
7	Determination of moisture content (wet basis and dry basis). chlorophyll, carotenoids etc.
8	Estimation of iron, copper, lead, tin etc.

Subject Code – BTFT407	**Food Processing Lab 05**	Max. Marks 100 Credits : 2

Sr .No	Name of Experiment
1	Bacteriological examination of foods: General protocol taking the examples of different foods. Presumptive coliform test of milk
2	Bacteriological examination of foods: General protocol taking the examples of different foods. , butter, cream
3	Bacteriological examination of foods: General protocol taking the examples of different foods ice-cream and dahi..
4	Bacteriological examination of foods: General protocol taking the examples of different foods. , Standard plate count for pasteurized milk and ice-cream
5	Bacteriological examination of foods: General protocol taking the examples of different foods. . Yeast and mold count for butter, dahi and bread
6	. To access bacteriological quality of milk by methylene blue reduction test
7	. To access bacteriological quality of milk by resazurin reduction test.

Semester-V

BTFT 501		**Subject name** BEVERAGE TECHNOLOGY	L-T-P 3-0-0	3 Credits
Teaching Scheme:		Examination Scheme:		
Lecture: 3 hrs./week		Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)		
Course Contents				
UNIT- 1	Status of the beverage industry in India. Its future prospects.			
UNIT- 2	Technology of manufacture of mineral water.			
UNIT- 3	Technology of manufacture of non-alcoholic beverages: fruits & vegetable juices, soft drinks, dairy beverages, etc.			
UNIT- 4	Technology of manufacture of alcoholic beverages: Beer, wine, whiskey, rum etc.			
UNIT- 5	Technology of manufacture of tea and coffee drinks.			
UNIT- 6	Design of equipments used in manufacturing of beverages. Plant layout.			

Books Recommended:

1. Woordroof & Phillips : : Beverages, AVI Publication, USA
2. Wangham, D.A. : Coffee & Tea, Interscience Publication, USA.
3. Ranganna : Handbook of Analysis of Fruit and Vegetable Products.

BTFT 502		**Subject name** MASS TRANSFER-I	L-T-P 3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Mass transfer operations, classification of mass transfer operations, choice of separation methods, methods of conducting mass transfer operations, design principles.
UNIT- 2	Introduction to mass transfer and diffusion, molecular diffusion in gases and liquids, diffusion coefficients for gases and liquids, diffusion in solids, types of solid diffusion
UNIT- 3	. Mass transfer coefficients, types of mass transfer coefficients, mass transfer coefficients in laminar flow, theories of mass transfer. Interphase mass transfer, concept of overall mass transfer coefficient.
UNIT- 4	Working principle, construction and industrial applications of various gas liquid contacting equipments like sparged vessels, mechanically agitated vessels, tray towers, packed towers, spray chambers, venturi scrubbers.
UNIT- 5	Humidification operations, psychometric chart, adiabatic saturation temperatures, wet bulb temperature, adiabatic operations, types of cooling towers
UNIT- 6	Principle of drying, batch drying, drying curve, constructional details and working of different dryers.

***Books Recommended*:**

1. 1. Treybal, Robert E. : 4. 5. : Mass Transfer Operations, 3rd Edition. McGraw-Hill, 1981.
2. Sherwood, T.K., Pifford, Robert L. and Wilke, Charles R. : Mass Transfer, McGraw-Hill.
3. 3. Sharma, K.R. : Principles of Mass Transfer, Prentice Hall of India Pvt. Ltd., 2007.
4. McCabe, Warren L., Smith Juliam C. and Harriott, Peter : Unit Operationsof Chemical Engg., 7th Edition, McGrawHill, 2005.

5. Sharma, K.R. : Principles of Mass Transfer, Prentice Hall of India Pvt. Ltd., 2007.

6. Coulson & Richardson : : Chemical Engineering, Vol.I (6th Edition, 2009) and Vol. II. (5th Edition, 2006).

BTFT503		**Subject name** **Food business management**	L-T-P 3-0-0	3 Credits
Teaching Scheme:		Examination Scheme:		
Lecture: 3 hrs./week Tutorial: 1 hrs./week		Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)		
Course Contents				
UNIT- 1	Definitions, management principles, scientific principles, administrative principles; Maslow's Hierarchy of needs theory; Functions of management: Planning, organizing, staffing, directing, controlling;			
UNIT- 2	Organizational structures, principles of organization; Types of organization: Formal and informal, line, line and staff, matrix, hybrid;			
UNIT- 3	Introduction to economics: Definitions, nature, scope, difference between microeconomics and macroeconomics; Theory of demand and supply, elasticity of demand, price and income elasticity;			
UNIT- 4	Theory of production: Production function, factors of production. Law of variable proportions and law of returns to scale; Cost: Short run and long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost; Break even analysis;			
UNIT- 5	Markets: Types of markets and their characteristics; National income: GDP, GNP, NNP, disposable personal income, per capita income, inflation; Finance management: Definition, scope, objective; Different systems of accounting: Financial accounting, cost accounting, management accounting;			
UNIT- 6	Human resource management: Definitions, objectives of manpower planning, process, sources of recruitment, process of selection; Corporate social responsibility: Importance,			

.TEXT BOOK Sr. No.	**Name of Book**	**Author**	**Publisher**
1	Agriculture, Finance		and Management

Reddy and Raghuram			Oxford & IBH Pub Co, 1996
2	Marketing Management	Kotler and Keller, Burton	Pearson Education Australia, 2008
3	Management: Principles and Guidelines	Duening and Ivacevinch	Dreamtech Press, 2003
REFERENCE BOOKS Sr. No.	Name of Book	Author	Publisher
1	L.M. Prasad	Principles andPractices of Management	2001
2	Principles of Management	Koontz Harold	Tata McGraw-Hill Education Private Limited, New Delhi.
3	Managerial Economics	P.C. Thomas	9th Ed. Kalyani Publishers
4	Modern Economic Theory	K.K. Dewett and M.H. Navalur	S. Chand & Sons, New Delhi.

BTFT504		**Subject name** PROCESSING OF CEREALS & PULSES	L-T-P 3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Composition, structure and quality, characteristics of cereal grains and pulses. Paddy Milling: Principles of milling of paddy. Traditional and modem methods of paddy milling. Parboiling of paddy, Paddy milling machinery. Processed foods from rice, byproducts of paddy milling and their uses.
UNIT- 2	Milling of Wheat: Criteria of wheat and flour quality, flour milling, wheat milling machinery. Rheology and Chemistry of dough, Physical dough testing instruments.
UNIT- 3	Technology of baking bread, biscuit, cookies, cakes. Durum wheat and pasta products like macaroni, noodles and spaghetti. Cereal based infant foods. fixation.
UNIT- 4	Corn Milling: Dry and wet milling of corn, corn based ready to eat breakfast cereals. Corn oilprocessing and utilization, Corn starch modification and uses, Corn sweeteners such as glucose syrup, high fructose corn syrups, dextrose, maltodextrin.

UNIT- 5	Milling of Pulses: Different methods of pulse milling. Pulse milling machinery. Application of enzymes in processing of cereals and pulses processing
UNIT- 6	Sanitation in the processing plant. Design of equipment used in milling of wheat, rice, corn and pulses. Plant layout.

Books Recommended:

1. Kent, N.L.: Technology of Cereals, CBS Publisher
2. Pomeranz, Y : Wheat Chemistry and Technology, CHIPS Book, USA.
3. Tanley A. Watson & Paul E. Ramstad: Corn Chemistry and Technology, ADCC, USA..
4. Julliano, B.O. : Rice Chemistry and Technology, AACC, USA.
5. Tanley A. Watson & Paul

BTFT504		**Subject name** PROCESSING OF FRUITS & VEGETABLES	L-T-P 3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Physiology of ripening. Effect of physical and chemical treatments on post harvest life of fruits and vegetables.
UNIT- 2	Role of plant growth regulators in post harvest storage, Storage and handling of fresh fruits and vegetables
UNIT- 5	Preservation of fruits and vegetables by heat treatment, Canning Processing and preservation of fruits and vegetable juices. Preparation of jams, jelly, marmalade, preserves, pickles and vegetable products.
UNIT- 4	Fermented fruit and vegetable products. Freezing and dehydration of fruits and vegetables. Concentration of fruits and vegetable juice.
UNIT- 5	Effects of processing on the nutritive value of fruits and vegetables. Food additives, Fermented foods, pickling and curing of food. Intermediate moisture foods, by product and their utilization.
UNIT- 6	Application of enzymes in processing of fruit and vegetable juices. Design of cleaning, cutting, blanching, and thermal processing equipments. Plant layout.

Books Recommended*:*

1. Giridhari Lal :. 4. : Preservation of Fruits & Vegetables, ICAR Publication, India.
2. Ranganna : : Analysis of Fruits land Vegetables, Tata MacGraw Hill, India.
3. Luh & Woodroof : : Commercial Vegetable Processing, AVI Publishing, USA

4. Woodroof & Luh : : Commercial Fruit Processing, AVI Publishing, USA Bhatt, V. I. & Vora, S. M.

Subject Code – BTFT506	**Process Equipent Design-I Lab**	Max. Marks 100 Credits : 2

Sr .No	**Name of Experiment**
1	Study of factors influencing the design of vessels; classification of pressure vessels, applications, method of fabrications, fundamental principles and equations.
2	Study of pressure vessel codes specifications and standards; Review of code and its development, ASME codes, API-ASME code, Section VIII of ASME codes
3	General design considerations for pressure vessels; Design pressure, design temperature, materials, design stress (nominal design strength), corrosion allowance, design loads, minimum practical wall thickness
4	Design of thin-walled vessels under internal pressure; Cylinders and spherical shells, heads and closures, design of flat ends, design of domes ends, conical sections and end closures.
5	Design of vessels subject to external pressure; Cylindrical shells, design of stiffening rings, vessels heads.
6	Design of vessels subject to combined loading: Weight loads, wind loads (tall vessels), torque
7	Design of welded joints and Bolted flanged joints.
8	Design of Foundation and supports.

***Books Recommended*:**

1. Battacharyya, B.C. : Introduction to Chemical Equipment Design Mechanica aspects, Chemical Engineering Education Development Centre.
2. Brownell and Young : Process Equipment Design , Willey Publication
3. Joshi, M.V. : Process Equipment Design, Macmillan India.

Subject Code – BTFT507	**Food Processing Lab 06**	Max. Marks 100 Credits : 2

Sr .No	**Name of Experiment**
1	Blanching of fruits and vegetables: Effect of temperature, time and selected compounds on blanching.
2	Preparation of fruit juices. Squashes, R- T -S, nectar.
3	Preparation of jam, marmalade preserve, candy.
4	Preparation of fruit juice concentrate and powder.
5	Preparation of tomato products.
6	Preparation of pickles, chutneys, sauces. Drying of fruits & vegetables.
7	Freezing of fruits & vegetables
8	Quality control of processed products.
9	Can seaming operation and canning of fruits and vegetables.
10	Visit to a fruit and vegetable processing plant.

Subject Code – BTFT508	**Food Processing Lab 07**	Max. Marks 100 Credits : 2

Sr .No	**Name of Experiment**
1	Milling of wheat. Evaluation of properties of wheat and milled products Physical, chemical and rheological.
2	Baking of bread, biscuit, cake, pastries. - Evaluation of baked bread.
3	Evaluation of properties of rice (physical and chemical). - Cooking quality of rice. - Experiment on parboiling, evaluation of quality. - Milling of rice, assessment of degree of polishing
4	Visit to flour mill, rice mill and pulse mill industries
5	Determination of heat transfer coefficient for different types of heat transfer equipment. Wilson plots.

6	Unsteady state heat transfer in jacketed vessels. (Open pan evaporator)
7	Correlation of instantaneous heat transfer coefficients with time study deposition of scale on a heating surface.
8	Determination of heat losses for insulated pipes
9	Study of double pipe heat exchanger and to determine overall heat transfer coefficient
10	Study and **operation** of long tube, forced circulation and multiple effect evaporators.

Subject Code – BTFT509	**Internship-II Evaluation**	Max. Marks 100 Credits : 1

Semester-VI

BTFT601		**Subject name** Mass Transfer-II	L-T-P 3-1-0	4 Credits
Teaching Scheme:			Examination Scheme:	
Lecture: 3 hrs./week Tutorial: 1 hrs./week			Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)	

Course Contents

UNIT- 1	Absorption: Equilibria for absorption systems – use of Raoult's law, Henry's law for solubility predictions, Selection of absorbent, limiting liquid gas ratios, absorption factor use in design of plate absorbers. Kremser equation for ideal plates and translation of ideal plates to real plates using various efficiencies. Concept of transfer units for the design of packed absorbers.
UNIT- 2	Distillation: Limitations and applications, prediction of VLE using thermodynamic & experimental techniques. Dew point & bubble point estimations for binary & multicomponent mixtures. Distillation methods – flash distillation, differential distillation for binary systems, steam distillation, optimum reflux ratio
UNIT- 3	Fractionation of binary mixtures using McCabe – Thiele method and enthalpy concentration method (Ponchon and Savarit method). Packed distillation columns. Azeotropic & extractive distillation preliminaries and molecular distillation.
UNIT- 4	Liquid-Liquid Extraction: Ternary Equilibria and its representation on various plots. Selection criteria for solvent, Multistage extraction using partially miscible & immiscible solvents. Stagewise contact for countercurrent and crosscurrent extraction. Constructional details of equipment like mixer-settler, packed columns, pulsed extractor, sieve-tray extractor and centrifugal extractor. Leaching: Preparation of solid, countercurrent and crosscurrent multistage contact Shank's system. Constructional details of equipment like Rotocel extractor, Hildebrandt extractor, Bollman extractor, Kennedy Extractor & Beet-Sugar Diffusion battery extractor.
UNIT- 5	Adsorption: Types of adsorption, nature of adsorbents, equilibria for adsorption systems. Brief manufacture and commercial applications and characteristics for common adsorbents. Stagewise & continuous contacting of fluid and solid phase. Description of contact filtration adsorption system. Hypersorber Ion-exchange system.
UNIT- 6	Crystallization: Growth and properties of crystals saturation, nucleation, growth of crystals, effect of impurities on crystal formation, effect of temperature on solubility, fractional crystallization, yield of crystals, crystal purity, yield calculation using phase diagram, energy requirements using enthalpy-concentration diagram. Methods of creating super saturationMeirs supersolubility curve. Mechanism and methods for nucleation. Derivation for ideal growth of crystals and discussion of actual growth. Swanson-Walker and various vacuum crystallizers.

Book Recommended

1. 1. Treybal, Robert E. : 4. 5. : Mass Transfer Operations, 3rd Edition. McGraw-Hill, 1981.

2. Sherwood, T.K., Pifford, Robert L. and Wilke, Charles R. : Mass Transfer, McGraw-Hill.

3. Skelland, A.H.P : Diffusion Mass Transfer, John Wiley & Sons., New York, 1974.

4. McCabe, Warren L., Smith Juliam C. and Harriott, Peter : Unit Operations of Chemical Engg., 7th Edition, McGrawHill, 2005.

5. King, C.J. : Separation Processes, Tata McGraw Hill Publishing Co. Ltd., New Delhi , 1982.

6. Geankoplis, C.J : Transport Process and Separation Processes, 4th Edition, Prentice Hall Inc., New Delhi, 2003.

BTFT602		Subject name SUPPLY CHAIN & LOGISTICS MANAGEMENT	L-T-P 3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Introduction to Supply Chain Management:Definition; Scope & Importance of Supply Chain Management; Key drivers Of the SCM; Features of Supply Chain Management; Supply Chain Network – 1st Tier , 2nd Tier; Network decisions in SCM; Suppliers and Customers; Customer Service Dimension (Seven "R" Principles, Service after sale, Customer delight)
UNIT- 2	Role of Logistics in Supply Chains: Definition of Logistics Management; Scope and role of Transportation, Traffic & transportation; Relationship between transportation and other business functions.
UNIT- 3	Transport Economics: Distance – volume-density, Freight Cost, Handling, Liability, market factors; Third party logistics (3 PL) & fourth party logistics service provider (4 PL), Logistics equipment; Reverse Logistics, Government rule & regulations related to Logistics; Purchase Cycle, Make or Buy, Price analysis, Negotiations.
UNIT- 4	Inventory Management: Inventory Control, Planning & Managing Inventories; Warehouse Management (Receipt, issue, storage and preservation, stock verification, In bound and out bound distribution operations); Order Management
UNIT- 5	Competitive advantage through logistics and supply chain management; Responsive Supply Chain; Supply chain process integration, performance measurement; Value Chain, Value System and Supply Chain.
UNIT- 6	Planning demand and supply: Planning & Sourcing in Supply Chain, Demand forecasting, Type and Time horizon of forecast and category of forecasting, aggregate planning; Financial issues in Supply Chain - Macro and micro view, Asset management, Du Pont Model, Supply Chain Costing; Decision environment in SCM; Global supply chain perspectives - New business models, role of IT in SCM.

Books Recommended:

1. Harald Dyckhoff et al, Ed.: Supply Chain Management and Reverse Logistics, Springer (India).
2. Jayashree Dubey and M.L. Saikumar Ed.: Supply Chain Management, IIPE Hyderabad and New Century Publication.
3. Sarika Kulkarni, Ashok Sharma: Supply Chain Management-Creating Linkages for Faster Business Turnaround, McGraw Hill.
4. RP Mohanty: Supply Chain Management-Theories and Practice, Biztantra.
5. Robert B. Handfield, Ernest L. Nicholas, Jr.: Introduction to Supply Chain Management,Pearson Education.
6. Ronald H. Ballou, Samir K. Srivastava: Business Logistics/Supply Chain Management, Pearson Education.
7. John Mentzer: Supply Chain Management, Response Books.

8. Janat Shah: Supply Chain Management, Pearson Publications.
9. N. Chandrasekaran: Supply Chain Management - Process, System and Practice, Oxford Press.

BTFT603	BSC7	**Subject name** **MEAT, FISH & POULTRY TECHNOLOGY**	L-T-P 3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Development of meat and poultry industry in India. Ante-mortem examination of animals and poultry birds. Slaughter and dressing, post mortem examination. post-mortem changes, factors affecting them and their effect on shelf life of meat.
UNIT- 2	Nutritive value of meat. Poultry dressing, wholesale and retail cuts. Communicated meat products. Canning of meat and meat products. Curing and smoking of meat. Meat tenderization.
UNIT- 3	Disposal and utilization of meat industry by-products. MFPO. Sanitation of abattoir and meat processing. Modified atmospheric packaging of meats.
UNIT- 4	Structure, composition and nutritive value of poultry eggs. Quality of eggs and its preservation. Egg Spoilage. Spray dried and frozen egg products.
UNIT- 5	Fish structure and composition, cold storage, freezing preservation and canning of fish. Pickling of fish, fish protein concentrates, fish meal and by-products of fish processing industry.
UNIT- 6	Sanitation in meat, fish, egg and poultry processing plants.

Books Recommended:

1. Henricksons, R.L : Meat, Poultry and Sea Food Technology, Prentice Hall.
2. Levie, Albert : Meat Hand Book, 4th Edition, AVI Publishing, Connecticut, 1984.
3. Mountney, G.J. and Poukhurst, C.R. : Poultry Products Technology, 3rd Edition, Food Products Press, 1995.
4. Borgstrom, George : Fish as Food (Vol. i, ii, iii, iv), Academic Press, New York, 1963.
5. Roberts, R.J. : Fish Technology.

EIECTIVE -II

BTFT604A	BSC7	**Subject name** CONFECTIONARY TECHNOLOGY	L-T-P 3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Types of confectionary goods. Characteristics and processing of raw materials.
UNIT- 2	Technology of manufacture of toffee, chocolate, fruit drops, hard-boiled candies, bars
UNIT- 3	Technology of manufacture of chewing gums, bubble gums and special confectionary goods.
UNIT- 4	Color, flavor and texture of confectionery. Standards and regulations. Economics and marketing of confectionery goods.
UNIT- 5	Design of equipments used in confectionary.
UNIT- 6	Plant layout.

Books Recommended:

1. Beckette : : Industrial Chocolate Manufacture: 3rd Edition, CBS Publication, New Delhi, 2000
2. Marie : : : Handbook of Sweeteners, CBS Publication, New Delhi,2000.

BTFT604B		**Subject name** **NANO TECHNOLOGY**	L-T-P 3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week	Continuous Assessment: 20 Marks Mid Semester

Tutorial: 1 hrs./week	Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Introduction: Plenty of room at the bottom-Feynman's concept, evolution of ultra-fine materials, the missing link between conventional laws in physics and chemistry and new theories. Building Blocks of Nanotechnology: covalent architecture, coordinated architecture and weakly bound aggregates, Interactions and topology
UNIT- 2	Chemical Properties: The effect of nanoscale metals on chemical reactivity, effect of nanostructure on mass transport, metal nanocrystallites support on oxides, supported nanoscale catalysts. General principles for synthesis of monodispersed nanoparticles, metals and intermetallics, Ceramics, composites, nanoparticles, colloids/Micelles/vesicles/Polymers/glasses, Crystalline, and zeolite hosts.
UNIT- 3	Review of fundamental behaviour of 0-D(nanoclusters), 1-D(nanowires), 2-D(thin film multilayers), and 3-D(bulk nanostructures) materials. Introduction to size dependent phenomenon in nanostructure for various applications, specific production techniques like chemical vapor deposition, arc ignition etc. Formation of clusters and nanoparticles from supersaturated vapor and selected properties, sputtering and thermal evaporation and laser methods. Synthesis of nanoparticles by chemical routes.
UNIT- 4	Approches to production: Top down and bottom up, Mechanical attrition, high energy ball milling, and mechanical attrition, nanocomposites by mechano-chemistry, mechanism of grain size reduction, property of microstructure relationships.
UNIT- 5	Characterization techniques : Tools in nanotechnology: Scanning electron microscopy(SEM), Transmission electron microscopy and high resolution(TEM), energy dispersive spectroscopy (EDX), Atomic force microscopy(AFM), Magnetic force microscopy(MFM), Chemical Force Microscopy(CFM), Focused ion beam, nanolithography, powder x-ray diffractometry, UV visible.
UNIT- 6	Nanomaterials: CNTs, Polymer Nanocomposites nanoceramics, nanometals, nanopolymers, structures-properties-applications, Quantum dots. Concepts Bio-Nanotechnology. Applications: Nanotherapeutics, Molecular diagnostics, tissue engineering, nanopumps, nanorobtoics cells, molecular motors, nanomembranes, Organic molecular based computers, bionanodevices (sensors & actuators).

Books Recommended

1. *Nanoscale Materials in Chemistry* by Kenneth J. Khabhunde (ed.) Wiley Interscience.
2. *Nanotechnology – An introduction to nanostructure of technique* by Michel Kohler and Wolfgang Frittsche 2004- Wiley VCH
3. *Springer Handbook of Nanotechnology by Bharat Bhushan*
4. *Encyclopedia of Nanotechnology- Hari Singh Nalwa.*
5. *Nanostructures and Nanomaterials* by G. Cao, Imperial College Press,2004
6. *Introduction to Nanotechnology* by Owen and Poole, Wiley
7. *Nano-materials* by A. K. Bandopadhyay, New Age International

BTFT602		**Subject name** CHEMICAL REACTION ENGINEERING	L-T-P 3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Introduction and a brief review of the kinetics of homogeneous reactions.
UNIT- 2	Interpretation of rate data from constant volume and constant pressure systems. Single Ideal reactors.
UNIT- 3	Design for single reactions.
UNIT- 4	Design for multiple reactions.
UNIT- 5	Thermal characteristics of reactors: temperature and pressure effects. Non-ideality in reactors and its effects on chemical conversion
UNIT- 6	One parameter models to represent the behaviour of chemical reactors.

***Books Recommended*:**

1. Levenspiel, O. : Chemical Reaction Engineering, 3rd Edition, John Wiley and Sons, 2004.
2. Smith, J.M. : Chemical Engineering, Kinetics, 3rd Edition, and McGraw Hill, 1981.
3. Dinbigh, K. & Turner, K.G. Chemical Reactor Theory – An Introduction, Cambridge Univ. Press.Hall, 2007.
4. Scott Fogler, H. : Elements of Chemical Reaction Engineering, 4th Edition, Prentice

BTFT604D		**Subject name** **FUNCTIONAL FOOD**	L-T-P 3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Definition of Nutraceuticals/ Functional foods and related terms, rationale to claim a compound as a nutraceutical, regulatory issues of nutraceuticals based on CODEX/FSSAI
UNIT- 2	Concept of angiogenesis and health foods vs. disease. Role of functional food on age related macular degeneration,
UNIT- 3	endurance performance and mood disorders-compounds and their mechanisms of action, dosage levels, contradictions if any
UNIT- 4	Extraction of selected nuraceuticals. Formulation of functional foods containing nutraceuticals-stability and analytical issues, labelling issues.
UNIT- 5	Identification testing of nutraceuticals and heath foods, interactions of prescription drugs and nutraceuticals,
UNIT- 6	adverse effects and toxicity of nutraceuticals, Nutrigenomics-an introduction and its relation to nutraceuticals.

References Books

1. Robert EC. 2006. Handbook of Nutraceuticals and functional foods. Wildman.
2. Shi J. 2006 Functional food Ingredients and Nutraceuticals: Processing Technologies, CRC Press.
3.Webb GP. 2006. Dietary supplement and Functional Foods. Blackwell Publications.

Open Elective-I

BTFT605A		**Subject name** PROCESS INSTRUMENTATION	L-T-P 3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	General Concept: Need and classification of measurements and instruments, Basic and auxiliary functional elements of a measurement system. Static and Dynamic Characteristics of Instruments: Static Characteristics: Range and span, accuracy and static error, reproducibility and drift, sensitivity and dead zone. Dynamic Characteristics: Speed of response and lag, fidelity and dynamic error, dead time. Temperature measurement:
UNIT- 2	Thermal expansion methods – bimetallic thermometers, liquid-in-glass thermometer and filled-in-system thermometers. Thermocouples, metal resistance thermometers and thermistors, optical and radiation pyrometers, radiation receiving elements.
UNIT- 3	Pressure measurement: Use of manometers, Bourdon gauge, bellows type gauge. Vacuum measurement–Mcleod gauge, thermoionic type ionization gauge, pirani vacuum gauge. Measurement of pressure in corrosive fluids: Diaphragm seal, liquid seal and purge system.
UNIT- 4	Liquid level measurement: Direct measurement of liquid level –Float & tape liquid level gauge, float and shaft liquid level unit, hydraulic remote transmission of liquid level.
UNIT- 5	Level measurement in open vessels: Bubbler system, diaphragm box system, air trap system. Level measurement in pressure vessels – Differential pressure manometer, use of liquid seals with a manometer, displacement float liquid level gauge. Measurement of viscosity, conductivity, humidity and pH.
UNIT- 6	Density measurement – liquid level method, displacement meter and hydrometer. Measurement of weight – spring scale, pneumatic force meter and hydrostatic force meter. Process Instrumentation–Recording instruments, indicating and signaling instruments, control centre, transmission of instrument reading, instrumentation diagrams.

Books Recommended:

1. Eckman, Donald P. : Industrial Instrumentation, CBS Publisher and Distributors, Indian

2004.

2. Singh, S.K. : IndustrialInstrumentationandControl,2nd Edition,TataMcGraw–Hill,2007.

3. Considine, D.N. : Process Instruments and Controls Handbook 2nd Edition, McGraw Hil

4. Fribance, A.E. : Industrial Instrumentation Fundamentals, Tata McGraw – HillPublis Ltd., 1962.

Patranabis, D. : Principles of Industrial Instrumentation, 2nd Edition, Tata McG Publishing Co. Ltd., 1999.

BTFT605B		**Subject name** Processing of Oil Seeds, Oils and Fats	L-T-P 3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Status of oils & fats and Indian economy. General chemistry. Analytical methods for characterization. Quality standards of edible oils & fats in diet, nutrition & disease. Detection of adulteration.
UNIT- 2	Oil milling methods: Ghani, mechanical expeller, hydraulic press, solvent extraction. Refining of edible oils & fats.
UNIT- 3	Basic processing of fats and oils - oil extraction, degumming, refining, bleaching, hydrogenation, fractional crystalization, interesterification, glycerolysis, molecular distillation, plasticizing and tempering. Chemical adjuncts-lecithins, monoglycerides and derivatives, propylene glycol esters, polyglycoesters.
UNIT- 4	Classification of vegetable oil. Modifications of the properties of oils & fats including chemical and biotechnological processes. Confectionary plastic fats
UNIT- 5	Preparation of various products including different shortenings, margarine, salad dressing & mayonnaise, imitation of dairy products low calorie spreads. Animal fat, oil derivatives
UNIT- 6	Technology of oilseed protein isolate. Utilization of byproducts from the oil milling industry. Design of oil milling equipments and plant layout.

***Books Recommended*:**

1. Bailey : Fats and Oil, Wiley, USA.
2. Solomons, T. W. G. : Fundamentals of Organic Chemistry, John Wiley and Sons, Inc., New York, 1994
3. Salunkhe, O.K. Chavan, J.K, Adsule, R.N. and Kadam,S.S.: World Oilseeds: chemistry, Technology and Utilization. VNR, New York, 1992
4. Wolf, I.A. Handbook of Processing and Utilization in Agriculture. CRC Press, Florida, Ed. 1983 (2 vol set)

5 Hamilton R.J.and Bharti A. Fats and Oils: Chemistry and Technology. Applied Science,

London. Ed. 1980.

BTFT605C		**Subject name** **FOOD RHEOLOGY & TEXTURE**	L-T-P 3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Basic Concepts of Stress and Strain, Elastic Solids: Hookean and Non-Hookean Behavior Classification of Fluid Behavior: Newtonian and Non-Newtonian Fluids - Shear Dependence, Time Dependence, Mechanical Models,
UNIT- 2	Determination of Flow Properties, Laminar Flow of Fluids, Circular Ducts, Between Parallel plates Modeling Rheological Behavior, Yield Stress Phenomena, Concepts of Dynamic and Static Yield Stresses, Viscoelastic Fluids,
UNIT- 3	Measurement Methods: Extensional Flow; Empirical Measurement Methods and Texture Profile Analysis; Farinograph; Mixograph; Cone Penetrometer; Warner-Bratzler Shear; Kramer Shear Cell; Melt Flow Indexer
UNIT- 4	Pipeline Design Calculations for Non-Newtonian Fluids, Fanning Friction Factors: Power Law and Bingham Plastic Fluids, Laminar and Turbulent Friction Losses in Valves and Fittings, Velocity Profiles in Laminar and Turbulent Flows Rheology as structural analysis tool for a) Solid food materials b) Fluid and semi-solid food materials
UNIT- 5	Description and measurement of solid food rheology: Dough, cheese, fruits and vegetables, extrudates Classification, description and measurement of fluid and semi-solid food rheology.
UNIT- 6	Rheology of food hydrocolloids dispersions, food suspensions, pastes, gels, emulsion. Method of measurement (objective/instrumental) of texture of food material. Correlation with sensory method. Food products specific textural aattributes, TPA etc.

References Books

2. Steffe, J.F., Daubert, J.F. (2006) Bioprocessing Pipelines: Rheology and Analysis, East Lansing, MI, Freeman Press

3. Steffe, J.F. (1996) Rheological Methods in Food Process Engineering, Second Edition, East Lansing, MI, Freeman Press

4. Rao, M.A., Steffe, J.F. (1992) Viscoelastic Properties of Food, New York, Elsevier Applied Science

BTFT605D		**Subject name** HEAT TRANSFER	L-T-P 3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Conduction: Steady state conduction in one dimensional system, general conduction equation, effect of variable thermal conductivity, steady state conduction involving internal heat generation, lagging on pipes, the critical thickness of insulation on pipes, extended surfaces of uniform thickness and fin effectiveness, fin efficiency.
UNIT- 2	Convection: Free and forced convection, concept of heat transfer co-efficient, dimensionless numbers in free and forced convection, Dimensional analysis, Determination of Heat transfer coefficient using heat and momentum transfer analogies, experimental determination of heat transfer coefficient and common working correlations.
UNIT- 3	32 Radiation Heat Transfer: Black Body radiation, and grey body radiation, physical mechanism, radiation properties and shape factor, heat exchange between non-black bodies, radiation shields pyrometry and effect of radiation on temperature measurement.
UNIT- 4	Condensation and Boiling: Condensation heat transfer phenomenon, film condensation on vertical plates and cylinders as well as on horizontal cylinders. Effects of non-condensable gases and vapor velocity on condensation, pool boiling, forced convection boiling, working correlations for pool boiling
UNIT- 5	. Evaporation: Types of Evaporators, single and multiple effects, single and multiple effects calculations, evaporator capacity, economy, effect of liquid head and boiling point elevation, methods of feeding.
UNIT- 6	Heat Exchangers: Various types of heat exchangers, overall heat transfer coefficients, heat exchanger mean temperature differences, heat exchanger effectiveness and the number of transfer units.

***Books Recommended*:**

1) Mc Cabe, W.L., Smith, J.C. 3. 4. 5. 6. 7. : Unit Operations of Chemical Engineering McGraw Hill.

2) Holman, J.P. : Heat Transfer, McGraw Hill Book Co.
3) Mc Adams, W.H. : Heat Transmission, McGraw Hill Book Co.
4) Chapmann, A.J.: Heat Transfer, Mc Millan Publishing Co
5) Kern, D.Q. : Process heat Transfer, McGraw Hill Book Co.

6) Kreith, F. : Principles of Heat Transfer, Harper & Row Pub., London.
7) Geankoplis, C.J. : Transport Processes and Unit Operations, Prentice Hall of India Pvt. Ltd., 3rd Edition, 1999.

BTFT605E		**Subject name** **WHEAT MILLING AND BAKING TECHNOLOGY**	L-T-P 3-0-0	3 Credits
Teaching Scheme:		Examination Scheme:		
Lecture: 3 hrs./week Tutorial: 1 hrs./week		Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)		
Course Contents				
UNIT- 1	**Wheat – importance, production verities used for cultivation Types of wheat, grading and quality of wheat**			
UNIT- 2	**Structure of wheat, chemical constituents and their distribution Physico-chemical and Rheological properties Enzymes in wheat, damage of wheat**			
UNIT- 3	**Conditioning of wheat – principles and methods of conditioning Milling of wheat: Rolling flour milling process; break rolls; reduction rolls; Design and operation, wheat milling process**			
UNIT- 4	**Products of wheat milling industry: Flour, atta, etc. flour grades, supplementation, Fortification Flour additives, flour improvers, Bleaching, Oxidizing agents**			

UNIT- 5	**Bakery products, role of bakery ingredients (major and minor),from hard wheat: bread processes of bread making using straight and sponge, dough methods role of each ingredient, quality control Testing of raw material testing of final product Defects in bread; staleness, roppines. Baked product from soft wheat; cookies, crackers, biscuits, cakes – ingredients, process, fault causes and remedy**
UNIT- 6	**Other bakery products: using very hard wheat. pizza, pastry and its types. Macaroni products: Including spaghetti, noodles, vermicelli-process. Nutritional improvement of bakery products Setting of bakery unit, bakery norms, specifications for raw materials Packaging, marketing of products, preparation of project report.**

TEXT BOOKS Sr. No.	**Name of Book**	**Author**	**Publisher**
1	Bakery Science and Cereal Technology	Khetarpaul. And	Daya Books, New Delhi 2005
2	Technology of Cereals	Kent.	Woodhead Publishing, 1994
3	Flour Milling Process	Scott JH	Chapman & Hall, 1951
4	Bakery Products Science and Technology	Zhou and Hui	John Wiley and Sons, 2014
REFERENCE BOOKS Sr. No.	Name of Book	Author	Publisher
1	Modern Bakery Products	EIRI	EIRI Publication, New Delhi
2	Dough Wheat and Baked Products	Faridi and Faubin	Springer, 2012
3	Baked Products	Stanley PC and Linda SY	Asia publishing house, Mumbai

Subject Code – BTFT606	**Process plant Design-II Lab**	Max. Marks 100	Credits : 2

Sr .No	Name of Experiment
1	Process design and specifications of double pipe heat exchanger, shell and tube heat exchanger, plate type heat exchanger, condenser and reboiler.
2	Design of distillation column, calculation of number of plates, height and design of fractionator internals- sieve tray.

3	Absorber/Stripper design of stage-wise and continuous contact equipment (packed column), height of column and diameter calculations. HTU and NTU.
4	Design aspects of fixed bed reactors and fluidized bed reactors.

Books Recommended:

1. Coulson, Richardson & Sinnott, R.K. : Chemical Engineering, Volume 6 – An Introduction to C Engineering Design, 4th Edition, Pergamon Press, 2007.
2. Ludwig, E.E. : Applied Process Design in Chemical and Petrochemical 2nd Edition, 1977.
3. Perry, J.H. : Chemical Engineers Handbook, 8th Edition, McGraw Hill,
4. Kern, D.Q. : Process Heat Transfer, McGraw Hill, 1965.
5. Shell and Tube Type Heat Standards. : Instt., IS: 43-197. Exchangers, Indian
6. Treybal, Robert E. : Mass Transfer Operations, 3rd Edition, McGra 1981.
7. Levenspiel, O. : Chemical Reaction Engineering, 3rd Edition, John W and Sons, 2004.
8. Walas, S.M. : Reaction Kinetics for Chemical Engg., McGraw Hill
9. Scott Fogler, H. : Elements of Chemical Reaction Engineering, 4th Edi Prentice Hall, 2007.

Subject Code – BTFT607	**Food Processing Lab 08**	Max. Marks 100 Credits : 1

Sr .No	**Name of Experiment**
1	Determination of mass transfer coefficients for naphthalene-air system.
2	To determine drying rate curves for different wet solids in a batch drier under constant drying conditions
3	Fractional approach to equilibrium for liquid-liquid extraction from single drop.
4	Verification of Rayleigh's equation for differential distillation.
5	Determination of flooding velocities in packed columns.
6	Determination of HETP for packed distillation columns.
7	Study and operation of a pilot sized distillation column under total reflux.

8	Kinetic studies in a semi batch reactor.
9	RTD studies in CSTR.
10	Dispersion number for packed bed reactor.
11	Adiabatic batch reactor.

Subject Code – BTFT608	**Food Processing Lab 09**	Max. Marks 100 Credits : 1

Sr .No	**Name of Experiment**
1	Fish & Meat: Cutting and handling.
2	Dressing of poultry.
3	Evaluation of quality of meat, fish & poultry.
4	Canning, freezing, dehydration & curing of meat & fish.
5	Quality of egg & egg powder, egg preservation.
6	Preparation of pettie, emulsion etc.
7	Kinetic studies in a batch reactor.
8	Kinetic studies in a plug flow reactor.
9	Kinetic studies in a CSTR.
10	Visit to meat, fish & poultry processing industries.

Semester-VII

BTFT701		**Subject name** **PROJECT MANAGEMENT AND ENTREPRENEURSHIP**	L-T-P 3-0-0	3 Credits
Teaching Scheme:		Examination Scheme:		

Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Introduction to Projects: Meaning & Definition of Project, Attributes of a Project, Difference among Projects, Routine Activities and Programs; Project Life Cycle
UNIT- 2	Project Planning: Work Breakdown Structure, Types of Work Breakdown Structure, Planning Framework and Its Importance Project Feasibility: Marketing, Technical & Financial Feasibility
UNIT- 3	Social Cost Benefit Analysis: Rationale, UNIDO and Little Mirrlees Approaches Project Schedule Planning; Network Analysis Techniques; Project Implementation; Project Monitoring & Control
UNIT- 4	Entrepreneur- Meaning & Definition of Entrepreneur, Characteristics of Entrepreneur, Nature and importance of Entrepreneur, Functions, Entrepreneur V/s Manager, Women Entrepreneurs.
UNIT- 5	Entrepreneurship: Concept, Policies Governing Entrepreneurs, Entrepreneurial Development Programmes, Contribution of Entrepreneurship to Economic Development
UNIT- 6	Institutions for Entrepreneurial Development; Role of Various Commercial Banks and Development financial Institutions.

Books Recommended

1. UNIDO: Guidelines for Project Evaluation, United Nations, reprinted,1993..
2. Mannual for the preparation of Industrial Feasibility Studies, United Nations1995.
3. Manual for Evaluation of Industrial Projects, United Nations, reprinted on 1993..
4. IMD little and J.A. Mirrlees: Project Apraisal and Planning in Developing Countries, 1975.
5. Prasanna Chandra: Projects: Preparation, Appraisal Budgeting and Control, 7th edition, TMH.
6. Vasanta Desai: Dynamics ofentrepreneurial development and management, 11th edition, Himalaya pub.

BTFT702		**Subject name** **FOOD REGULATION & QUALITY CONTROL**	L-T-P 3-1-0	4 Credits
Teaching Scheme:		Examination Scheme:		

Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)
Course Contents	
UNIT- 1	General Principles of Quality Control, Quality Attributes: Colour, gloss, viscosity and consistency, size, shape and texture, flavour, taste,

UNIT- 2	sensory evaluation techniques. Microbiological methods of quality evaluation.
UNIT- 3	Application of Biosensors to check the quality of packaged food products
UNIT- 4	Government and trade standards for quality.
UNIT- 5	Food Laws and Regulations: PFA, FPO, BIS, AGMARK, ISO, etc.
UNIT- 6	Quality of Different Food Products: Cereals, fruits, vegetables, milk, egg, meat, fish etc

Books Recommended:

1. Krammar and Twigg : Quality Control for Food Industry, AVI Publishing, 1979.
2. Herschdoerfar, S.N. : Quality Control in Food Industry, Academic Press, U.K.
3. Ranganna : Handbook of Analysis of Fruit and Vegetable Products, Tata McGraw Hill, New Delhi, 1986.

BTFT703		**Subject name** Processing of Milk and Milk Products	L-T-P 3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Present status of milk & milk products in India and Abroad; market milkComposition of milk of various species, quality evaluation and testing of milk, procurement, transportation and processing of market milk, cleaning & sanitization of dairy equipments. Special milks such as flavoured, sterilized, recombined & reconstituted toned & double toned.
UNIT- 2	Condensed milk- Definition, methods of manufacture, evaluation of condensed & evaporated milk; dried milk- Definition, methods of manufacture of skim & whole milk powder, instantiation, physiochemical properties, evaluation, defects in dried milk powder.
UNIT- 3	Cream- Definition, classification, composition, cream separation, sampling, neutralization, sterilization, pasteurization & cooling of cream, evaluation, defects in cream; Butter- Definition, composition, classification, methods of manufacture, theories of churning,

	evaluation, defects in butter.
UNIT- 4	Ice cream- Definition, composition and standards, nutritive value, classification, methods of manufacture, evaluation, defects in ice cream, and technology aspects of softy manufacture.
UNIT- 5	Cheese: Definition, composition, classification, methods of manufacture, cheddar, Gouda, cottage and processed cheese, evaluation, defects in cheese.
UNIT- 6	Indigenous milk products - Present status, method of manufacture of yoghurt, dahi, khoa, burfi, kalakand, gulabjamun, rosogolla, srikhand, chhana, paneer, ghee, lassi etc; probiotic milk products. Practical Study on basics of reception of milk at the plant; platform tests in milk; estimation and fat and SNF in milk; Operation of LTLT & HTST Pasteurization; Preparation of special milks; Cream separation & standardization of milk; Preparation and evaluation of table butter, icecream, cheese and indigenous milk product such as khoa, chhana, paneer, ghee, rosogolla, gulab jamun, shrikhand, lassi, burfi etc.; Visit to dairy plants.

***Books Recommended*:**

1	Aneja RP, Mathur BN, Chandan RC & Banerjee AK	Technology of Indian Milk Products. Dairy India Publ. 2002
2	De S.	Outlines of Dairy Technology. Oxford Univ. Press. 1980.
3	Henderson JL.	: 1971. Fluid Milk Industry. AVI Publ.
4	Spreer E.	: 1993. Milk and Dairy Products. Marcel Dekker.
5	Walstra P.	: Dairy Technology. Marcel Dekker, 1999

Elective-III

BTFT704A		**Subject name** **BIOCHEMICAL ENGINEERING**	L-T-P 3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Isolation and Utilization of Enzymes: Purification, immobilization, application of enzyme technology.
UNIT- 2	Kinetics of Enzyme-Catalyzed Reactions: The substrate, enzyme kinetics, factors affecting enzymatic activity and enzymatic reactions in heterogeneous reactions.

UNIT- 3	Metabolic Pathways and Energetics of the Cell: The concept of energy coupling, aerobic and anaerobic metabolism, photosynthesis and biosynthesis, transport across cell membranes. Cellular Genetics and Control: Growth and reproduction of a single cell, alteration of cellular DNA, commercial applications.
UNIT- 4	Kinetics of Substrate Utilization. Product Yield and Biomass Production: Growth cycle for batch cultivation and its mathematical modeling, products synthesis kinetics, thermal death kinetics of cells and spores
UNIT- 5	Transport Phenomena in Microbial Systems: Gas-liquid mass transfer, determination of oxygen transfer rates, mass transfer, surface-area correlations for mechanically agitated vessels, scaling of mass transfer equipment, particulate mass transfer, heat transfer.
UNIT- 6	Design and Analysis of Biological Reactors: The ideal continuous-flow stirred-tank reactor (CSTR), residence time distribution, different types of reactors, relationship between batch and continuous biological reactors. Fermentation technology, product manufacture by fermentation, reactors for biomass production.

Books Recommended*:*

1. Balley & Ollis : Biochemical Engineering Fundamentals, McGraw Hill Book Co., 1986.
2. Aiba Humphrey & Millis : Biochemical Engineering, Academic Press, 1973.
3. Whitaker Stanbury &Whitaker, Hall: Principles of Fermentation Technology, Adita Books, New Delhi, 1997.

BTFT704B		**Subject name** **FOOD BIOTECHNOLOGY**	L-T-P 3-0-0	3 Credits
Teaching Scheme:		Examination Scheme:		
Lecture: 3 hrs./week		Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)		

Course Contents

UNIT- 1	Introduction to food biotechnology, genetic engineering and its importance in food Technology. Advantages and disadvantages of genetically modified foods.
UNIT- 2	Technological aspects of industrial production fermented foods, beverages, vitamins, antibiotics, baker's yeast, single cell protein. Bio-colors, bio-flavors. Classification of fermentation

UNIT- 3	Application of fermentation technology in food preservation. Regulatory and social aspects of biotechnology of foods.
UNIT- 4	Production of alcohol, lactic acid and acetic acid from various food materials. Bacteriocin production and its use in food preservation.
UNIT- 5	Biotechnological processes of manufacture of functional foods, nutraceuticals and probiotics. Biotechnological process for food fortification, prebiotics & oligosaccharides
UNIT- 6	Application of biotechnology in waste treatment of food industries. Improvement of quality of food by biotechnological processes. Biosensors.

Reference Books:

1. Daniel Charles. Lords of the Harvest: Biotech, Big Money, and the Future of Food (1st Edition). Perseus Books Group, 2001.
2. Adams, M.R. and M.O. Moss. Food Microbiology. Turpin Distribution Service Ltd., Blackhorse Road, Letchworth, Herts SG6 1HN, UK, 1995, 2nd edition.
3. Gauri Mittal.Food Biotechnology: Techniques and Applications. CRC Press, 1992.
4. Banwart, George J. Basic Food Microbiology, 2nd ed. AVI/ Van Nostrand Reinhold Publishing Co, 1989.
5. Cliver, D.D. Foodborne Diseases. Academic Press, Inc, 1990.
6. Food and Drug Administration. Bacteriological Analytical Manual (BAM) (8th 21 Edition). AOAC, Arlington, VA, 1995.
7. Debnath, 2005, Tools & Techniques of Biotechnology, Pointer Publishers, Jaipur.

BTFT704C		**Subject name** **PLANT UTILITIES**	L-T-P 3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks

	End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Importance of Process utilities in Chemical Plant.
UNIT- 2	Compressed air and Vacuum: Reciprocating air compressors, vacuum pumps, air receivers, piping systems.
UNIT- 3	Steam: Boiler, steam handling and distribution steam nozzles.
UNIT- 4	Refrigeration: Air refrigeration cycle, vapour compression cycle, liquification processes.
UNIT- 5	Power Generation: Internal Combustion engines. Gas turbines, steam power plants.
UNIT- 6	Water: Water Resources, storage & distribution of water reuse & conservation of water.

Books Recommended:

1. Jouganson, R. : Fan Engineering, Buffalo Rorge Co., 1970.
2. Wangham, D.A. : Theory and Practice of Heat Engines, ELBS Cambridge University Press, 1960.
3. Lyle, O. : Efficient Use of Steam, HMSO, 1963.
4. Stoccker, W.F. : Refrigeration and Air Conditioning, Mc-Graw Hill, 1950.
5. Kurl, W.F. J.H.M. : Reuse of Water in Industry, Butterworth, London.

BTFT704D		**Subject name** Food Referigeration & Cold Storage	L-T-P 3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Principles of refrigeration: Definition, background with second law of thermodynamics, unit of refrigerating capacity, coefficient of performance; Production of low temperatures Common refrigerants and their properties: classification, nomenclature,

UNIT- 2	desirable properties of refrigerants- physical, chemical, safety, thermodynamic and economical Azeotropes; Components of vapour compression refrigeration system, evaporator, compressor, condenser and expansion valve Ice manufacture,
UNIT- 3	principles and systems of ice production, Treatment of water for making ice, brines, freezing tanks, ice cans, air agitation,
UNIT- 4	quality of ice Cold storage: Cold store, design of cold storage for different categories of food resources, size and shape, construction and material, insulation, vapour barriers, floors, frost-heave, interior finish and fitting, evaporators, automated cold stores
UNIT- 5	security of operations Refrigerated transport: Handling and distribution, cold chain, refrigerated product handling, order picking,refrigerated vans, refrigerated display Air-conditioning: Meaning, factors affecting comfort air-conditioning, classification, sensible heat factor, industrial air-conditioning Problems on sensible heat factor; Winter/summer/year round air-conditioning, unitary air-conditioning systems, central air-conditioning Physiological principles in air-conditioning, air distribution and duct design methods
UNIT- 6	Design of complete air-conditioning systems; humidifiers and dehumidifiers Cooling load calculations: Load sources, product cooling, conducted heat, convected heat, internal heat sources, heat of respiration, peak load; etc

TEXT BOOK Sr. No.	**Name of Book**	**Author**	**Publisher**
1	Refrigeration and Air Conditioning	C.P. Arora	2nd Ed. Tata McGraw-Hill Publishing Co. Ltd., New Delhi. 2000
2	Textbook of Refrigeration and Air Conditioning	R. S. Khurmi & J. K. Gupta	Eurasia Publishing House Pvt. Ltd., New Delhi 1999
3	Basic Refrigeration and Air Conditioning	Ananthanarayan PN	4th Edition, McGraw Hill, Delhi 2013
4	Refrigeration and Air Conditioning	Hundy GF, Trott AR and Welch TC	Elsevier, 2008

REFERENCE BOOKS Sr. No.	**Name of Book**	**Author**	**Publisher**
1	Refrigeration and Air Conditioning	W.F. Stoecker and J.W. Jones	2nd Ed. McGraw-Hill Book Co., New York, USA. 1982
2	Refrigeration & Air Conditioning Technology	William C. Whitman, William	6th Ed. Delmar, Cengage Learning, NY, USA. 2017

3	Refrigeration and Air Conditioning	Arora RC	PHI Learning, New Delhi 2010

Open Elective-II

BTFT705A		**Subject name** **OPERATIONS RESEARCH**	L-T-P 3-0-0	3 Credits
Teaching Scheme:		Examination Scheme:		
Lecture: 3 hrs./week		Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)		
Course Contents				
UNIT- 1	Linear Programming: problem formulation, graphical method, simplex method, duality sensitivity analysis.			
UNIT- 2	Transportation model, Transhipment problem, traveling salesman problem			
UNIT- 3	, Assignment models, Sequencing model, Replacement model.			
UNIT- 4	Theory of Games: Pure strategy games, principle of dominance; mixed strategy games (Algebraic, Graphical & Linear programming method), 2-person, non-zero- sum games.			
UNIT- 5	Queuing Theory: Introduction, elementary queuing system; single channel queuing model, queuing cost behaviour, multiple channel queuing model,			
UNIT- 6	Poisson arrivals and Erlang service distribution; benefits and limitations of queuing theory.			

Books Recommended:

1. Vohra, N.D. : Quantitative Techniques in Management; 2nd Edition, Tata McGraw Hill.
2. Gupta, P.K. andHira, D.S. : Operation Research, S. Chand, New Delhi.
3. Swarup Kanti, Gupta,P.K. and Man Mohan: Operation Research, 12th revised Edition, Sultan Chand & Sons, New Delhi;

BTFT705B		**Subject name** PROCESS DYNAMICS & CONTROL	L-T-P 3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks

	End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Incentives for chemical process control, design aspects of a process control system. Difference between feedback and feed forward control configuration. Hardware elements of a control system, Block Diagrams.
UNIT- 2	Laplace transform and transfer functions. Difference between lumped and distributed parameter systems, Dynamic behaviour of first and higher order systems, interacting and non- interacting systems, dead time.
UNIT- 3	Different modes of control actions and their basic characteristics, controllers and their characteristics, control valve.
UNIT- 4	Closed-loop transfer functions, transient response of simple control systems, Routh stability criterion, Root Locus.
UNIT- 5	Introduction to frequency response: Bode diagrams, control system design by frequency response: Ziegler-Nichols controller settings, stability using frequency response, gain margin and phase margin.
UNIT- 6	Introduction to advanced control techniques such as cascade control, feed forward control, ratio control, inferential control.

Recommended Books

2. Coughanowr, D.R. : Process Systems Analysis and Control, 2nd Edition. Mc Graw Hill, 1991.

3. Stephanopolous G. : Chemical Process Control -An Introduction to Theory and Practice, Prentice Hall of India, New Delhi, 2008.

4. Luyben W. L. and Luyben M.L.: Essentials of Process control, Mc Graw Hill International Editions, 1997.

5. Ogata K.: System Dynamics, 4th Edition, Pearson Education, 2004.

Harriott, P. : Process Control, TMH Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1972.

7. Vasanta Desai: Entrepreneurial development, and Management, 13th edition, Himalaya pub., Harper Collins, edition- Paperback.
8. Peter F. Drucker: Innovation and development.

BTFT705C		**Subject name** **INDUSTRIAL SAFETY & HAZARDS**	L-T-P 3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Definition, identification, classification and assessment of various types of hazards in work-place environment, protective and preventive measures in hazard control.
UNIT- 2	Toxic Chemicals: maximum allowable concentrations and other standards. Biological threshold limit values.
UNIT- 3	Mechanical and electrical hazards. Personal protective equipments. Explosives and inflammable substances. Radioactive hazards. Fire prevention. Good housekeeping in industrial environment.
UNIT- 4	Standard safety procedures and disaster control.
UNIT- 5	Indian Legislation on safety and prevention of hazards and safety code: ISO 14000
UNIT- 6	Environmental impact assessment. Control strategies for hazardous wastes. Case Studies of typical hazardous industries.

Books Recommended:

1) Wills, G.L. : Safety in Process Plant Design.
2) Less, F.P. : Loss Prevention in Process Industries.
3) Chanleft, E.T. : Environmental Protection.
4) Berhowex, P.M. & Rudd, D.F ; Strategy of Pollution Control.
5) Safety for Chemical Engineers : A.I.Ch.E. Publications, 1976-77.

BTFT705D		**Subject name** **PACKAGING TECHNOLOGY**	L-T-P 3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:

Lecture: 3 hrs./week Tutorial: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Contents

UNIT- 1	Basic concepts, function of food package, packaging materials, cellulosic, glass, metal, polymeric composite, rigid, semi-rigid and flexible package forms,
UNIT- 2	adhesive, band and closure, coatings and labels, packaging, product characteristics and packaging requirements,
UNIT- 3	selection of material, form, machinery and method of packaging, package printing, standards and regulations. Active Smart packaging and Edible packaging
UNIT- 4	Special problems in packaging of foodstuffs. Biodegradable packaging.
UNIT- 5	Design of packaging equipments.
UNIT- 6	Evaluation of packaging materials for different food products and package performance. Use of Nanocomposites in food packaging

Books Recommended:

1. Pines, F.A. : Fundamentals of Packaging, Cornhill Publication, London.
2. David, J.R. & David, D.R.D. : Aseptic Processing and Packaging & Food, CRC Press.

3. Sacharow & Griffin : Food Packaging, AVI Publishing, Westport, Conn.
4. Brody, A.L. : Flexible Packaging of Foods, CRC Cleveland, Ohio Press.
5. Heiss, R. : Principle of Food Packaging, An International Guide United Nations

Food & Agricultural Organization, Rome, Italy, 1970.

Subject Code – BTFT707	**Food Processing Lab 10**	Max. Marks 100 Credits : 1

Sr .No	**Name of Experiment**
1	Strength properties of packaging materials.
2	Water vapour and gas transmission rates of flexible packaging materials.
3	Identification of plastic films.
4	Pre-packaging of vegetables.
5	Shrink packaging of poultry.
6	Estimation of shelf life of packaged foods.
7	Vacuum and gauge packaging.
8	Performance evaluation of transport packaging.

Subject Code – BTFT707	**Food Processing Lab 11**	Max. Marks 100 Credits : 1

Sr .No	**Name of Experiment**
1	To plot the response curve for a given input to a U-tube manometer. To determine the transfer function from the response curve obtained in part (a).
2	To study the dynamics of the given thermometer and compare the theoretical value of its time constant with the experimental value.
3	Develop a block diagram representing the dynamic bahavoiur of the given globe valve.
4	(a) Liquid level measurement With the given Bubbler System for Liquid Level Measurement, evaluate liquid height in the tank and compare it with actual values. (b) Calibration of Pressure Gauge Calibrate a pressure gauge in the range 0 psi to 60 psi.
5	Temperature control system

6	Physical and chemical analysis of milk & milk products.
7	Testing the adulteration in milk & milk products.
8	Preparation of cream, butter, ghee, ice-cream, milk powder and condensed milk.
9	Quality evaluation of milk products.

Subject Code – BTFT708	**Project Work (Food Process Plant Design-III)**	Max. Marks 100 Credits : 1

Subject Code – BTFT709	**Industrial Traing & Seminar**	Max. Marks 100 Credits : 1

Subject Code – BTFT710	**Internship-III Evaluation**	Max. Marks 100 Credits : 1