

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

**B.TECH COURSE IN
FOOD TECHNOLOGY
(2012 Admission onwards)**

SEMESTER III

Course code	Subject	L Hrs/ wee k	T Hrs /we ek	P Hrs/ week	Cre dit	Inter nal	Uni vers ity	Total
CE/CS/EB/EC/EE/ EI/IT/ME/SE/FT 1301	Engineering Mathematics II	3	1	0	3	50	100	150
FT 1302	Physical Chemistry	4	0	0	3	50	100	150
FT 1303	Organic Chemistry	4	0	0	3	50	100	150
FT 1304	Microbiology	3	1	0	3	50	100	150
FT 1305	Biochemistry and Nutrition	3	1	0	3	50	100	150
FT 1306	Theory of machines	3	1	0	3	50	100	150
FT 13L1	Microbiology Lab	0	0	3	2	100		100
FT 13L2	Physical and Organic Chemistry Lab	0	0	3	2	100		100
Total		20	4	6	22	500	600	1100

SEMESTER IV

Course code	Subject	L Hrs/ wee k	T Hrs /we ek	P Hrs/ week	Cre dit	Inter nal	Uni vers ity	Total
CE/CS/EB/EC/EE/E I/IT/ME/SE/FT 1401	Engineering Mathematics III	3	1	0	3	50	100	150
FT 1402	Principles of Chemical Engineering	3	1	0	3	50	100	150
FT 1403	Heat and Mass Transfer	3	1	0	3	50	100	150
FT 1404	Unit Operations in Food Processing	3	1	0	3	50	100	150
FT 1405	Refrigeration and Cold Chain	4	0	0	3	50	100	150
FT 1406	Food Microbiology	4	0	0	3	50	100	150
FT 14L1	Food Microbiology Lab	0	0	3	2	100		100
FT 14L2	Unit Operations Lab	0	0	3	2	100		100
Total		20	4	6	22	500	600	1100

SEMESTER V

Course code	Subject	L Hrs/week	T Hrs/week	P Hrs/week	Credit	Internal	University	Total
CE/CS/EB/EC/EE/EI/IT/ME/SE/FT 1501	Engineering Mathematics IV	3	1	0	3	50	100	150
FT 1502	Food Chemistry and Additives	4	0	0	3	50	100	150
FT 1503	Food Process Engineering	3	1	0	3	50	100	150
FT 1504	Principles of Food Processing and Preservation	4	0	0	3	50	100	150
FT 1505	Food Process Equipment and Design	3	1	0	3	50	100	150
FT 1506	Food Analysis	3	1	0	3	50	100	150
FT 15L1	Food Analysis Lab	0	0	3	2	100		100
FT 15L2	Food Chemistry and Biochemistry Lab	0	0	3	2	100		100
Total		20	4	6	22	500	600	1100

SEMESTER VI

Course code	Subject	L Hrs/week	T Hrs/week	P Hrs/week	Credit	Internal	University	Total
FT1601	Fruit and Vegetable Processing	3	1	0	3	50	100	150
FT1602	Dairy Plant Engineering	3	1	0	3	50	100	150
FT1603	Cereals,Pulses and Oilseeds Processing	4	0	0	3	50	100	150
FT1604	Food Product Design and Development	3	1	0	3	50	100	150
FT1605	Food Plant Layout and Design	3	1	0	3	50	100	150
FT1606	Elective I	4	0	0	3	50	100	150
FT 16L1	Food Processing Lab	0	0	3	2	100		100
FT 16L2	Mini Project	0	0	3	2	100		100
Total		20	4	6	22	500	600	1100

FT1606 ELECTIVE I

FT1606 E1 Fermentation and enzyme technology

FT1606 E2 Food flavourings

FT1606 E3 Food laws and regulations

FT1606 E4 Plant maintenance safety and hygiene

SEMESTER VII

Course code	Subject	L Hrs/week	T Hrs/week	P Hrs/week	Credit	Internal	University	Total
FT1701	Food Quality system and Management	3	1	0	3	50	100	150
FT1702	Engineering Properties of Food	3	1	0	3	50	100	150
FT 1703	Food packaging Technology	3	1	0	3	50	100	150
FT 1704	Instrumentation and Process Control	3	1	0	3	50	100	150
FT 1705	Elective II	3	1	0	3	50	100	150
FT 17L1	Food Preservation Lab	0	0	3	2	100		100
FT 17L2	Engineering Properties Lab	0	0	3	2	100		100
FT 17L3	Project Design	0	0	2	1	50		50
FT 17L4	Seminar	0	0	2	2	50		50
Total		15	5	10	22	550	500	1050

FT1705 ELECTIVE II

FT 1705 EI – Beverage processing

FT1705 E2 – Food process modelling

FT1705 E3 – Technology of meat poultry and egg processing

FT1705 F4 – Bakery and confectionary technology

SEMESTER VIII

Course code	Subject	L Hrs/week	T Hrs/week	P Hrs/week	Credit	Internal	University	Total
FT 1801	Management of Food Processing Industries	3	1	0	3	50	100	150
FT 1802	Entrepreneurship Development for Food Technology	4	0	0	3	50	100	150
FT 1803	Technology of Plantation Crops and Spices	3	1	0	3	50	100	150
FT 1804	Elective III	4	0	0	3	50	100	150
FT 18L1	Project	0	0	14	8	300		300
FT 18L2	Viva Voce	0	0	0	2		100	100
Total		14	2	14	22	500	500	1000

FT1804 ELECTIVE III

FT1804 E1 – Fish processing technology

FT1804 E2 – Food biotechnology

FT1804 E3 – Food industry waste management

FT1804 E4 – Nutraceuticals and functional foods

1101 ENGINEERING MATHEMATICS I

Module 1

Ordinary differential equations:

First order differential equations - exact differential equations, Bernoulli's equations--Methods of solution and Simple applications.

Linear differential equations of higher orders with constant co-efficients-Methods of solution of these equations. Cauchy's linear differential equations. Simultaneous linear differential equations- Simple applications of linear differential equations in engineering problems –Electrical Circuits, Mechanical Systems.

Module 2

Infinite series : Integral test, comparison test, ratio test, Cauchy's root test, Raabe's test, series of positive and negative terms, concept of absolute convergence, alternating series, Leibniz test(No proofs for any of the above tests)

Power series : Taylor and Maclaurin series of functions, Leibniz formula for the nth derivative of the product of two functions (No proof),use of Leibniz formula for the determination of co-efficients of the power series.

Module 3

Partial differentiation: Partial differentiation-Concept of partial derivative - Chain rule- Total derivative- Euler's theorem for homogeneous functions, Differentials and their applications in errors and approximations, Jacobians - Maxima minima of functions of two variables(Proof of the result not required)-Simple applications.

Co-ordinate systems: Rectangular co-ordinates-Polar co-ordinates-In plane and in Space-Cylindrical polar co-ordinates-Spherical polar co-ordinates.

Module 4

Integral calculus:

Application of definite integrals: Area, Volume, Arc length, Surface area.

Multiple integrals : Evaluation of double integrals-Change of order of integration. Evaluation of triple integrals-Change of Variables in integrals.

Applications of multiple integrals. Plane Area, Surface area & Volumes of solids

Text Books:

S.S.Sastry, Engineering Mathematics -Vol1, PHI publishers

Erwin Kreyzig, Advanced Engineering Mathematics, Wiley Eastern

References:

T.Veerarajan, Engineering Mathematics, TMGH Publishers

B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

1102 ENGINEERING PHYSICS

Module 1

Laser-introduction--spontaneous and stimulated emission-principle of laser- properties of laser-Einstein coefficients and the analysis of lasing conditions- Basic components of a laser-Different types of lasers-construction,working and applications of Ruby laser-Neodymium YAG laser- He-Ne laser-semiconductor laser-Applications of laser in medicine, industry, science and communication.

Holography-basic principle-Comparison with ordinary photography-Recording and reconstruction of holograms-applications.

Fibre optics - Basic structure of an optical fibre - step-index fibre and graded index fibre- propagation of light in an optical fibre-acceptance angle and acceptance cone- Numerical aperture of a step-index fibre-Numerical aperture of a graded index fibre-modes of propagation-step index monomode fibre-Multimode stepindex fibre- Graded multimode fibre-Attenuation in optic fibres-fibre losses-material loss,scattering loss,absorption loss,leaky modes- dispersion in optical fibres- Applications.

Module 2

Crystallography – Space lattice- Basis- Unit cell- Unit cell parameters- Crystal systems- Bravais lattices- Three cubic lattices-sc, bcc, and fcc- Number of atoms per unit cell- Co-ordination number- Atomic radius-Packing factor- Relation between density and crystal lattice constants- Lattice planes and Miller indices-Separation between lattice planes in sc- Bragg's law- Bragg's x-ray spectrometer- Crystal structure analysis.

Liquid crystals- Liquid crystals, display systems-merits and demerits- Metallic glasses- Types of metallic glasses (Metal-metalloid glasses, Metal-metal glasses) – Properties of metallic glasses (Structural, electrical,magnetic and chemical properties).

Shape memory alloys- Shape memory effect, pseudo elasticity

Module 3

Introduction to nanoscale science and technology- nanostructures-nanoring, nanorod, nanoparticle, nanoshells- Properties of nanoparticles- optical, electrical, magnetic, mechanical properties and quantum confinement- Classification of nanomaterials- C60, metallic nanocomposites and polymer nanocomposites-Applications of nanotechnology.

Superconductivity-Introduction--transition temperature-Meissner effect-properties of superconductors.Types of superconductors-type 1 and type 2- AC Josephson's effect- DC Josephson's effect-Flux quantisation-Squid-High temperature superconductors-Applications of super conductivity.

Special Theory of Relativity - Michelson-Morley experiment. Einstein's postulates. Lorentz transformation equations (no derivation). Simultaneity. Length contraction. Time dilation. Velocity addition. Relativistic mass. Mass energy relation. Mass less particle.

Module 4

Quantum mechanics-Introduction-origin of quantum theory-black body radiation and photo electric effect (brief ideas only)-matter waves- wave packet-uncertainty principle-(two forms)Time dependent Schrodinger equation for a free particle-Particle in force field and time dependent Schrodinger equation-

Time independent schrodinger equation-Physical interpretation of wave function-application -Particle in a Box (one dimensional) –Energy eigen values and wave functions

Ultrasonics-piezo electric effect-Magnetostriction effect-production of ultrasonics-properties of ultrasonics- ultrasonic diffractometer and determination of velocity of ultrasonics in a liquid-Application of ultrasonics in non destructive testing - Acoustics of building-reverberation- Absorption Coefficient-Sabines formula for reverberation time(Derivation)-Acoustic intensity- loudness-decibel-phon-conditions for good acoustics(Qualitative study).

References:

1. S. Mani Naidu, A Text book of Engineering Physics, Pearson, 2010
2. M.C. Santosh Kumar, Engineering Physics, Nalpat Publishers.
3. B. Premlet, Advanced Engineering Physics, Phasor Books, Kollam.
4. A.S. Vasudeva, Modern Engineering Physics, S. Chand & Co.
5. Prabir K. Vasu and Hrishikesh Dhasmana, Engineering Physics, Ane books Pvt. Ltd., 2010.
6. S.O. Pillai & Sivakami, Applied Physics, New Age International (P) Ltd., Second Edition 2008.
7. G.S. Raghuvanshi, Engineering Physics, Prentice Hall of India.

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

1103 ENGINEERING CHEMISTRY

Module 1

Solid state chemistry: Fundamentals, Bonding in solids, Born-Haber cycle, Point defects, Methods to improve reactivity of solids, Free electron theory, Band theory, Fermi level in semiconductors, Molecular field theory of magnetic materials.

Spectroscopy: Molecular energy levels-Types of molecular spectra- Electronic spectra (Classification of electronic transitions- Beer Lamberts law, Vibrational spectra (mechanism of interaction and application), Rotational spectra (Determination of bond length and application). NMR spectra (Basic principle, chemical shift, spin-spin splitting)

Solid surface characterisation: Electron spectroscopy for chemical analysis, Chemical shift, BET isotherm, Thermodynamics of adsorption.

Module 2

Electrochemistry: Fundamentals, Electrode potential, Nernst's equation, Types of electrodes, Salt bridge, E.M.F measurement. Concentration cells, Calculation of E.M.F of a concentration cell.

Acids and bases, Arrhenius concept, Bronsted-Lowry concept of acids and bases, Lewis concept, Buffer solutions, pH measurement, Polarisation, Overvoltage.

Power generation: Secondary cells, Fuel cells, Photovoltaic effect, Solar cells.

Corrosion and its control: Theories of corrosion - Galvanic series- Types of corrosion - Factors affecting corrosion and different methods of corrosion control.

Chemical Kinetics: reaction rate, rate constant, rate law, reaction order, first order, second order, pseudo-first order reactions, integrated rate laws, half-life of a reaction and its relation to rate constant. Molecularity, simple unimolecular and bimolecular reactions. Arrhenius equation.

Module 3

Chemical Thermodynamics: Fundamentals, Molecular interpretation of internal energy, enthalpy and entropy, Heat of reaction, Kirchhoff's equation, Trouton's rule, Entropy changes accompanying different processes, Nernst heat theorem, Third-law.

Free energy: Dependence on pressure and temperature, Gibbs-Helmholtz equation, Free energy changes and equilibrium constant, chemical potential, Fugacity, Thermodynamics of biochemical reactions.

Phase Rule: Terms involved in phase rule and examples, Application of phase rule to one component water system, Application of phase rule to two-component systems.

Module 4

Engineering materials:

Polymers- Classifications- Mechanism of polymerisation (Addition, free radical, cationic, anionic and coordination polymerisation)- Thermoplastics and thermosetting plastics-Compounding of plastics-Moulding techniques of plastics (Compression, Injection, Transfer and Extrusion moulding)-Preparation, properties and uses of PVC, PVA, Nylon, PET - Silicon polymers- Biodegradable plastics. Elastomers-structure of natural rubber- vulcanisation- synthetic rubbers (Buna-S, Butyl rubber and Neoprene).

Lubricants- Introduction-Mechanism of lubrication- solid and liquid lubricant- Properties of lubricants- Viscosity index- flash and fire point- cloud and pour point- aniline value.

Refractories: Classification – Properties of refractories.

Cement- Manufacture of Portland cement- Theory of setting and hardening of cement.

References:

1. Peter Atkins, Julio de Paula, Elements of Physical Chemistry, Oxford University Press, 2005.
2. John E. McMurry and Robert C. Fay, Chemistry, 5th Edition, Pearson, 2008.
3. O. G Palanna, Engineering Chemistry, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2009.
4. R.N. Goyal, Harmendra Goel, Textbook of Engineering Chemistry, 2nd Edition, Ane Books Pvt. Ltd., 2011.
5. R Gopalan, D Venkappayya, Sulochana Nagarajan, Textbook of Engineering Chemistry, 2nd Edition, Vikas Publishing House Pvt. Ltd., New Delhi, 2005.
6. Shashi Chawla, A Text Book of Engineering Chemistry, Dhanpat Rai & Co, New Delhi, 2003.
7. Kochubaby Manjooran, Modern Engineering Chemistry, Kannantheri Publication, Kochi.

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

1104 ENGINEERING MECHANICS

A) STATICS

Module 1

Concurrent forces in a plane: Principles of statics. Composition and resolution of forces. Equilibrium of concurrent forces in a plane. Method of projection. Method of moments. Friction.

Parallel forces in a plane: Two parallel forces. General case of parallel forces in a plane. Centre of parallel forces and centre of gravity, Pappus theorems, centroids of composite plane figures and curves. Distributed forces in a plane.

Module 2

Properties of areas: . Moment of inertia of a plane figure with respect to an axis in its plane. Polar moment of inertia. Product of inertia. Principal axes. Mass moment of inertia of material bodies.

General case of forces in a plane: Composition of forces in a plane. Equilibrium of forces in a plane. Plane trusses - Method of joints. Method of sections. Plane frames : Method of members. **Principle of virtual work:** Equilibrium of ideal systems, stable and unstable equilibrium.

B) DYNAMICS

Module 3

Rectilinear translation: Kinematics of rectilinear motion. Differential equation of rectilinear motion. Motion of a particle acted upon by a constant force, by a force as a function of time and by a force proportional to displacement. Simple harmonic motion. D'Alembert's principle. Momentum and impulse. Work and energy, ideal systems, conservation of energy. Impact.

Module 4

Curvilinear translation: Kinematics of curvilinear translation. Differential equations of motion. Motion of a projectile. D'Alembert's principle in curvilinear motion. Moment of momentum. Work and energy in curvilinear motion.

Rotation of a rigid body: Kinematics of rotation. Equation of motion of a rigid body rotating about a fixed axis. Rotation under the action of a constant moment. Compound pendulum. General case of moment proportional to the angle of rotation. D'Alembert's principle of rotation. Resultant inertia force in rotation. Principle of angular momentum in rotation. Energy equation for rotating bodies.

References

1. Timoshenko and Young, Engineering Mechanics, McGraw Hill Book Company.
2. Beer F. P. and Johnston E. R, Mechanics for Engineers (Vol. 1- Statics and Vol.2 -Dynamics), Tata McGraw Hill.
3. Merriam H. L. & Kraige L. G, Engineering Mechanics (Vol. 1- Statics and Vol.2 -Dynamics), John Wiley and Sons.
4. Biju N, Engineering mechanics, Educational Publications.

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

1105 ENGINEERING GRAPHICS

Module 1

Introduction to engineering graphics- Drawing instruments and their use. familiarisation with current Indian Standard Code of Practice for general engineering drawing. Scales- plain scale ,vernier scale, diagonal scale.

Conic sections- Construction of ellipse, parabola, hyperbola - construction of cycloid, involute, archimedean spiral and logarithmic spiral- drawing tangents and normals to these curves.

Module 2

Introduction to orthographic projections- plane of projection- principles of first angle and third angle projections, projection of points in different quadrants.

Orthographic projection of straight lines parallel to one plane and inclined to the other plane- straight lines inclined to both the planes- true length and inclination of lines with reference planes- traces of lines. Projection of plane laminae of geometrical shapes in oblique positions.

Module 3

Projection of polyhedra and solids of revolution- frustum, projection of solids with axis parallel to one plane and parallel or perpendicular to other plane- projection of solids with axis inclined to both the planes- projection of solids on auxiliary planes.

Section of solids by planes inclined to horizontal or vertical planes- true shape of sections.

Module 4

Development of surface of cubes, prisms, cylinders, pyramids and cones

Intersection of surfaces- methods of determining lines of intersection - intersection of prism in prism and cylinder in cylinder.

Module 5

Introduction to isometric projection- isometric scales, isometric views- isometric projections of prisms, pyramids, cylinders, cones and spheres.

Introduction to perspective projections : visual ray method and vanishing point method- perspective of circles- perspective views of prisms and pyramids.

References:

1. K.C. John. Engineering Graphics, PHI Learning
2. P.I. Varghese and K.C. John, Engineering Graphics, JET Publishers
3. N.D.Bhat , Elementary Engineering Drawing, Charotar publishing house
4. P.S.Gill , Geometric Drawing, B.D Kataria & Sons, Ludhiana
5. P I Varghese , Engineering Graphics, VIP Publishers

University Examination Question Paper pattern

Two questions of 20 mark each from all the five modules. Answer one question from each module

1106 BASIC CIVIL AND MECHANICAL ENGINEERING

PART- A: BASIC CIVIL ENGINEERING

Module 1

Engineering Materials: Cement - varieties and grade of cement and its uses. Cement mortar- Steel- types of steel for reinforcement bars, steel structural sections. Brick- varieties and strength, tests on bricks.

Aggregates- types & requirements. Concrete- grades of concrete as per IS code, water cement ratio, workability, mixing, batching, placing, compaction and curing.

Construction : Foundation- types of foundations- isolated footing, combined footing, raft, pile & well foundations- Foundation for Machinery

Module 2

Super structure: Brick masonry, English bond and Flemish bond, Stone masonry-Ashlar masonry- Rubble masonry. Roofing- Steel trusses, roofing for industrial buildings

Surveying: Principles, instruments, ranging and chaining of survey lines, errors in chaining, field work, field book, selection of survey stations, reconnaissance.

Leveling: Leveling instruments, different types, temporary adjustments, mean sea level, reduced level of point, booking of field notes, reduction of levels by height of collimation method.

References:

1. S.C. Rangawala, Engineering Materials, Charotar Publishing House, Anand.
2. Roy M. Thomas, Fundamentals of Civil Engineering, Educational Publishers,Ernakulam
- 3 Surendra Singh, Building Materials, Vikas Publishing Company, New delhi.
- 4 S.C. Rangawala, Building Construction, Charotar Publishing House, Anand.
5. P. Kanetkar, Surveying and Levelling, Volumes 1 and 2, United Book Corporation, Poona.

PART A - Type of Questions for University Exam. (Maximum Marks: 50) (To be answered in separate answer book)

Q 1 Four short answer questions of 5 marks each with two questions from each modules. (4x5 = 20 marks)

Q 2. to Q.5 : Two questions A & B of 15 marks from each module with option to answer either A or B. (2 x 15 = 30 marks)

PART – B: BASIC MECHANICAL ENGINEERING

Module 1

Thermodynamics: Thermodynamics systems – open, closed and isolated systems, equilibrium state of a system, property and state, process, cycle, Zeroth law of thermodynamics- concept of temperature, temperature scales. First law – internal energy, enthalpy, work and heat, Different processes, isobaric, isochoric, isothermal and adiabatic processes Second law – Kelvin-plank and Clausius statements, Carnot Cycle.

Internal Combustion Engines: Air standard cycles – Otto and Diesel cycles, working of two stroke and four stroke Petrol and Diesel engines, Carburetted and MPFI engines, fuel pump, fuel injector, ignition system, cooling system, lubricating system.

Module 2

Refrigeration and Air conditioning: Vapour compression and vapour absorption refrigeration systems, summer, winter and comfort air conditioning.

Manufacturing processes – Casting (sand and die casting processes), Forging (open & closed die forging), Rolling, Extrusion, Welding (resistance, arc and gas), brazing and soldering

Elementary ideas of **simple reaction and impulse turbines**, compounding of turbines.

Transmission of power: Belt drives (open and closed), Chain drives.

Text Books & References:

1. P.K. Nag, Engineering Thermodynamics, Tata McGraw Hill
2. J.P. Holman, Thermodynamics, Mc Graw Hill
3. Rogowsky, Elements of Internal combustion Engines, Tata McGraw Hill
4. Gill, Smith & Ziurys, Fundamentals of Internal Combustion Engines, Oxford & IBH
5. Stoecker, Refrigeration and Air Conditioning, Tata McGraw Hill
6. Raghavan : Material Science and Engineering, Prentice Hall of India

PART B - Type of Questions for University Exam. (Maximum Marks: 50) (To be answered in separate answer book)

Q 1 Four short answer questions of 5 marks each with two questions from each modules. (4x5 = 20 marks)

Q 2. to Q.5 : Two questions A & B of 15 marks from each module with option to answer either A or B. (2 x 15 = 30 marks)

1107 BASIC ELECTRICAL & ELECTRONICS ENGINEERING

Part (A) ELECTRICAL ENGINEERING

Module I

Resistance : Circular wires – Wire Tables – Temperature Effects – Types of Resistors – Colour Coding and Standard Resistor Values – Conductance – Ohmmeters – Metric Units –The Memristor.

Ohm's Law, Power and Energy : Ohm's Law – Plotting Ohm's Law – Power – Energy – Efficiency – Circuits Breakers, GFCI's and Fuses – Applications .

Series dc Circuits: Series Resistors – Series Circuits – Power Distribution and Series circuit – Voltage Sources in a Series – Kirchoff's Voltage Law – Voltage Division in a Series Circuit – Interchanging Series Elements – Notation – Voltage Regulation and the Internal Resistance of Voltage Sources.

Parallel dc Circuits: Parallel Resistors – Parallel Circuits – Power Distribution in a Parallel Circuit – Kirchoff's Current Law – Current Divider Rule – Voltage Sources in Parallel – Open and Short Circuits.

Capacitors: The Electric Field – Capacitance – Capacitors.

Inductors: Magnetic Field – Inductance.

Module II

AC Fundamentals: Sinusoidal Alternating Waveforms - Sinusoidal ac Voltage Characteristics and Definitions – Frequency Spectrum – The Sinusoidal Waveform – General format for the sinusoidal Voltage of current – Phase Relations – Average Value – Effective (rms) Values – ac Meters and Instruments. Elementary Concepts of Energy Meter Watt Meter, Volt Meter and Ammeter.

The Basic Elements and Phasors: Response of Basic R,L and C Elements to a Sinusoidal Voltage or Current – Frequency Response of the Basic Elements – Average Power and Power Factor – Complex Numbers – Rectangular Form – Polar Form – Conversion between Forms.

Series and Parallel ac Circuits: Impedance and the Phasor Diagram- Series Configuration – Voltage Divider Rule – Frequency Response for Series ac Circuits –Admittance and Susceptance – Parallel ac Networks – Current Divider Rule – Frequency response of Parallel Elements.

Introduction to 3 phase Systems: Star Δ Connection

Elementary Concepts of Generation, Transmission, and Distribution: Various Levels of Power Transmission – Conventional Sources of Electrical Energy, Hydro, Thermal, Nuclear and Diesel Power Station - Introduction to Primary and Secondary distribution - Basic Concepts of Transformers - Principle of Operation – Applications to Power Systems.

Part (B) ELECTRONICS ENGINEERING

Module III

The Diode - Biasing the Diode, Voltage - Current Characteristic of a Diode, Diode Models, Testing a Diode.

Diode Applications - Half Wave and Full Wave Rectifiers, Power supply Filters and Regulators

Special Purpose Diodes - Zener Diodes- Applications, Varactor Diodes, Optical Diodes-Other Types of Diodes- system application.

Bipolar Junction Transistors (BJTs) - Transistor Structure - Basic Transistor Operation, Transistor characteristics and parameters, Transistor as an Amplifier, Transistor as a Switch.

Module IV

Sensors-Temperature, light, force and sound sensors; **Actuators** – Heat, Light, force and sound actuators.

Electronic measurements - measurements of voltages and currents, voltmeter, ammeter, multimeter, CRO (Block level treatment only)

Introduction to Electronic Communication systems: Modulation and Demodulation, Analog communication system, Electromagnetic frequency spectrum, Bandwidth and information capacity, Principles of Amplitude and angle modulation, Bandwidth requirements of angle modulated waves.

Optical communication: Fundamental concepts, Block diagram of an optical fibre communications system.

Cellular Telephone: Fundamental concepts, Frequency reuse, Block diagram of a simplified cellular telephone system, Roaming and handoffs

Satellite communication: Block diagram of Satellite system link models – Uplink, Transponder Downlink.

Text Books:

1. Boylestad, *Introductory Circuit analysis*, Pearson Education, 12/e, 2012. [Module 1,2].
2. Thomas L. Floyd, *Electronic Devices*, Pearson Education Inc. 7th edition. [Module 3]
3. Neil Storey, *Electronics A systems approach*, Pearson Education Inc. 2011 [Module 4]
4. Wayne Tomasi, *Electronic Communication Systems: Fundamentals through Advanced*, Pearson Education Inc. 5th edition. [Module 4]

Reference:

1. Smarajit Ghosh, *Fundamentals of Electrical and Electronics Engineering*, PHI Ltd, 2nd edition.
2. R.Muthusubramanian and S.Salivahanan, *Basic Electrical and Electronics Engineering*, TMH 2011.
3. Debashis De, *Basic Electronics*, Pearson Education Inc. 2010.

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

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1108 COMPUTER PROGRAMMING

Module 1

Basics of Computer and Information Technology:

Digital Computer System (CPU, Memory, I/O devices)- Working of a digital computer- Hardware and Software : Definition - Categories of Software, Application of Computers – Role of Information Technology – Internet Services

Problem Solving Methodology:

Program - Programming Process (Problem statement, Analysis, Design a solution, Implement/Coding the solution, Test the solution, Iteration through the phases to refine/correct the program)- Design tools (Algorithm, Flow-chart, Pseudo-code)- Develop algorithms for simple problems.

Module 2

Programming Languages:

Types and generation of programming languages- Compiler – Interpreter-Linker –Loader –Execution of Program

Basics of C:

Character set-Identifier- Keywords- Constants –Data Types- Variables and declaration –Operators and Expressions – Operator precedence and associativity – Expression Evaluation (Simple Examples) - Input and output functions – Simple computational problems involving the above constructs.

Module 3

Control Statements:

Selection, Conditional operator, Iteration (for, while, do-while), Branching (switch, break, continue, goto), Nesting of control statements- Problems using control statements.

Arrays and Strings:

1D and 2D arrays –Searching (Linear and Binary) - Sorting (Bubble, Selection) – Matrix manipulation programs – Strings and basic operations on strings – Strings functions - Programs on string manipulation

Functions:

Definition – Calling – Declaration – Parameter Passing (by value and by reference) – Recursion – Library functions –Programs based on functions

Module 4

User defined data types:

Structure – Union - Enumerated data type - Programs involving structure and union.

Pointers:

Declaration, Initialization – Pointers and arrays – Pointers and structures – Pointers and functions – Command line arguments – Dynamic memory allocation – Operations on pointers – Programs involving the above concepts

Files:

File concept–File pointer–File handling operations (open, close, read, write etc) on sequential and random access files. Programs on file manipulations using fgetc(), fgets(), fseek

Text Books and References:

1. Pradip Dey and Manas Ghosh, Computer Fundamentals and Programming in C, Oxford.
2. Samarjit Ghosh, All of C, PHI Learning
3. Byron Gottfried , Programming with C , 2nd edition, TMH publication.
4. B.W. Kernighan and D.M. Ritchie, The C Programming Language, Pearson Education.
5. R G Dromey , How to solve it by Computer, Prentice Hall
6. D.E. Knuth, The Art of Computer Programming – Volume 1,2 &3, Addison Wesley.
7. Yashwant P. Kanetkar, Let Us Use C, 8th Edition (Paperback).
8. Sukhendu Dey , Complete Knowledge in C, Narosa
9. Varghese Paul, Computer Fundamentals , EPD.

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

1109 ENVIRONMENTAL STUDIES AND TECHNICAL COMMUNICATION

PART – A: ENVIRONMENTAL STUDIES (1 hour / week)

Module 1

Natural resources - issues related to the use and over exploitation of forest resources, water resources, mineral resources, food resources, energy resources and land resources- role of an individual in conservation of natural resources - equitable use of resources for sustainable life styles.

Concept of an ecosystem - structure and function - energy flow in the ecosystem - ecological succession - food chains, food webs and ecological pyramids - structure and functions of a forest ecosystem and an aquatic eco system.

Definition of biodiversity - genetic, species and ecosystem diversity - biogeographical classification of India - Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Threats to biodiversity, Conservation of biodiversity.

Module 2

Environmental Pollution - Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, marine pollution, thermal pollution and nuclear hazards - Causes, effects and control measures of urban and industrial solid wastes -Role of an individual in prevention of pollution - An overview of the various environmental legislations in India - Issues involved in enforcement of environmental legislation. Disaster Management: Floods, earth quake, cyclone and landslides. Role of public awareness in disaster management.

The concept of sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, water shed management - Resettlement and rehabilitation of people; its problems and concerns - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies - Population growth and problems of population explosion – Environment and human health – Human rights – Value education – Role of Information Technology in environment and human health - Environmental ethics: issues and possible solutions.

References:

1. Rajagopalan. R, Environmental Studies: From Crisis to Cure, Oxford University Press, 2005
2. Erach Bharucha, Textbook of Environmental Studies and Ethics, Universities Press (India), Hyderabad, 2005.
3. Jayashree A. Parikh, V.M. Balsaraf, P.B. Dwivedi, Environmental Studies, Ane Books Pvt. Ltd., 2010.
4. Anindita Basak, Environmental Studies, Pearson, 2009.
5. Gouri Suresh, Environmental Studies and Ethics, I.K. International Publishing House Pvt. Ltd., New Delhi, 2007.
6. S.P. Misra, Essential Environmental Studies, 3rd Edition, Ane Books Pvt. Ltd., 2011.
7. Benny Joseph, Environmental Science & Engineering, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
8. Meenambal T , Uma R M and K Murali, Principles of Environmental Science and Engineering, S. Chand & Company Ltd, 2005

PART – B: TECHNICAL COMMUNICATION (1 hour / week)

This is a practice oriented, need based, and functional – communicative course. It is intended to develop the student's skill of communication in listening, speaking, reading and writing. The student is advised to cultivate the habit of reading newspapers, magazines and books in a free, extensive manner to consolidate the skill already achieved. A more inter-active process of teaching/learning is called for in order to achieve effective communication.

Questions at the class tests and semester end examination will be largely problem solving and application oriented in nature.

Module 1

Communicative Grammar: Time, tense and aspect; Verbs of state and event; Use of preposition; Expressing emotions and attitudes: Hope, anticipation of pleasure, disappointment, approval, disapproval, surprise.

The sounds of English: (it is not a course in phonetics. Technical terms will not be used except when absolutely necessary.)

Length of vowels-long and short vowels

/ /, / 3 : /, / a : /, / : /, / U : / | / / 2 /, /, / Λ /, / O /, / U / - Consonants : / f, v, o, o, s, z, 3 / - Stress pattern -

Intonation: falling and rising.

Oral Communication: starting and ending a conversation; telling and asking people to do things; expressing opinions and ideas, decisions and intentions, offers and invitations, feelings, right and wrong, numbers and money.

Purpose and audience; dealing with customers and clients; face-to-face discussions; interviews; group discussions; meetings and attending meetings; checking understanding; raising questions; giving and receiving feedback; using body language; leading and directing discussions; concluding discussions; using graphics in oral presentations

Reading Comprehension and reference skills: skimming and scanning; factual and inferential comprehension; prediction; guessing meaning of words from context; word reference; comprehending graphics in technical writing.

Reading strategies; reading speed; reading between the lines for hidden meaning; interpreting graphics; using a dictionary; using an index; using a contents list to find information; choosing the right reference source.

Module 2

Written Communication: note making and note taking; summarizing; notes and memos; developing notes into text; organization of ideas: cohesion and coherence; Preparing notes – writing business letters and E-mail messages. Organizing a meeting, preparing an agenda, chairing a meeting, drafting motions and resolutions, writing minutes.

Paragraph writing: Paragraph writing – Topic sentence, cohesion and coherence- sentence liners (so, but, however etc), ordering information in space and time; short essays: description and argument; comparison and contrast; illustration; using graphics in writing: tables and charts; diagrams and flow-

charts; maps, plans and graphs. Preparation of a business report-writing a business proposal - format, length, structure.

Spelling rules and tips; writing a rough draft; editing and proof reading; writing the final draft; styling text; filling in complex forms; standard letters; Writing a curriculum vitae (both chronological & functional) along with an application for a job; Public relation – Concept and relevance – PR in a business organization-handling the media; writing a report; writing leaflets and brochures; writing references; essay writing: expository writing; description of processes and products; classification; the instructional process; arguments and presentation of arguments; narrating events chronologically.

References:

1. John Seely, Oxford Guide to Writing and Speaking, Oxford University Press.
2. C. Muralikrishna and Sunita Mishra, Communication Skills for Engineers, 2nd Edition, Pearson, 2011.
3. Meenakshi Raman and Sangeetha Sharma, Technical Communication: Principles and Practice, Oxford University Press, 2004.
4. Krishna Mohan and Meenakshi Raman, Effective English Communication, Tata Mc-GraHill, 2000.
5. William Sanborn Pfeiffer, T.V.S. Padmaja, Technical Communication – A Practical Approach, Pearson, 2007.
6. R.C. Bhatia, Business Communication, 2nd Edition, Ane Books Pvt. Ltd., 2008.
7. Krishna Mohan and Meera Banerji, Developing Communication Skills, Mac Millan India Ltd, 2000.

University Examination Pattern

The question paper will have two parts. Part A and Part B will have a weightage of 50 marks each and they will have to be answered in separate answer books.

Question Paper Pattern for Part A (Environmental Studies)

Q I. – 6 short type questions of 3 marks each, with three questions from each module (6 x3 = 18)

QII. – 2 questions A and B of 16 marks from Module I with choice to answer one. Both A and B should have a minimum of two sub – sections.

QIII - 2 questions A and B of 16 marks from Module II with choice to answer one. Both A and B should have a minimum of two sub – sections.

Question Paper Pattern for Part B (Technical Communication)

Q I – 10 short answer questions of 2 marks each, with five questions from each module. The questions shall be problem solving and application oriented in nature.

QII. – 2 questions A and B of 15 marks from Module I with choice to answer one. Both A and B should have a minimum of two sub – sections. The questions shall be problem solving and application oriented in nature.

QIII - 2 questions A and B of 15 marks from Module II with choice to answer one. Both A and B should have a minimum of two sub – sections. The questions shall be problem solving and application oriented in nature

11 L1 ELECTRICAL AND MECHANICAL WORKSHOP

ELECTRICAL WORKSHOP

1. One lamp controlled by one switch 2. Series and parallel connections of lamps.
3. Stair case wiring.
4. Hospital Wiring.
5. Godown wiring.
6. Fluroscent lamp.
7. Connection of plug socket.
8. Different kinds of joints.
9. Transformer winding.
10. Soldering practice.
11. Familiarisation of CRO

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MECHANICAL WORK SHOP

Preliminary exercises for beginners in all the following shops. Specific models may be designed by the teachers.

- 1) Fitting Shop.
- 2) Sheet Metal Shop
- 3) Foundry Shop
- 4) Welding Shop
- 5) Carpentry Shop

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 50 % minimum in the end semester examination for a pass.

11 L2 COMPUTER PROGRAMMING LABORATORY

Application packages

- | | |
|--------------|--|
| Word | 1. To create an advertisement in Word.
2. To illustrate the concept of mail merging in word. |
| Spread Sheet | 3. To create a spread sheet to analyse the marks of the students of a class and also to create appropriate charts. |
| Power Point | 4. To create the presentation for the department using Power Point. |

C Programming Basics

- | | |
|-------------------------|---|
| Operators & Expressions | 5. To write a simple menu driven calculator program using switch statement |
| IO Formatting | 6. To write a program to print Pascal's triangle. |
| Decision Making | 7. To write a program for electricity bill preparation. |
| Looping | 8. To write a program to print the sine and cosine series. |
| Arrays | 9. To write a program to perform Matrix multiplication.
10. To write a program to prepare and print the sales report. |
| String | 11. To write a program to perform string manipulation Manipulations function like string concatenations, comparison, find the length and string copy without using library functions.
12. To write a program to arrange names in alphabetical order. |
| Functions | 13. To write a C program to calculate the mean, variance and standard deviation using functions. |

14. To write a C program to perform sequential and binary search using functions.

Recursion

15. To write a program to print the Fibonacci series and to calculate the factorial of the given number using functions.

Structures

16. To print the mark sheet of n students using structures.

Pointers

17. To write a program using pointers to access the elements of an array and count the number of occurrences of the given number in the array.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 50 % minimum in the end semester examination for a pass.

11 L3 LANGUAGE LABORATORY

The **Language Lab** focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations and contexts.

Objectives:

1. To expose the students to a variety of self-instructional, learner-friendly modes of language learning.
2. To help the students cultivate the habit of reading passages from the computer monitor, thus providing them with the required facility to face computer-based competitive exams.
3. To enable them to learn better pronunciation through stress on word accent, intonation, and rhythm.
4. To train them to use language effectively to face interviews, group discussions, public speaking.
5. To initiate them into greater use of the computer in resume preparation, report writing, format-making etc.

Syllabus :

The following course content is prescribed for the **English Language Laboratory** sessions:

1. Introduction to the Sounds of English- Vowels, Diphthongs & Consonants.
2. Introduction to Stress and Intonation.
3. Situational Dialogues / Role Play.
4. Oral Presentations- Prepared and Extempore.
5. 'Just A Minute' Sessions (JAM).
6. Describing Objects / Situations / People.
7. Information Transfer
8. Debate
9. Telephoning Skills.
10. Giving Directions.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 50 % minimum in the end semester examination for a pass.

SEMESTER III

FT 1301 ENGINEERING MATHEMATICS 1I

Module I

Matrices and Vector spaces: Rank of matrix, Echelon and normal form, Solutions of linear systems of algebraic equations, Eigen values and Eigen vectors, Cayley Hamilton theorem (non proof).

Vector Spaces – Subspaces, - Linear Independence of vectors-Linear span-Dimension and Basis. Linear transformations.

Module II

Fourier series and Fourier integrals: Forier series of Periodic functions- Euler formulae for Fourier coefficients- functions having period 2π , arbitrary period-even and odd functions-half range expansions, Fourier integral, Fourier cosine and sine transformations, linearity property, transform of derivatives, convolution theorem (no proof)

Module III

Laplace transforms: Linearity property, transforms of elementary functions, Laplace transforms of derivatives and integrals, differentiation and integration of transforms, convolution theorem (no proof) use of Laplace transforms in the solution of initial value problems, unit step function, impulse function - transform of step functions, transforms of periodic functions.

Module IV

Vector calculus: Scalar and Vector point functions-Gradient and directional derivative of a scalar point function-Divergence and Curl of a vector point functions-their physical meanings.

Evaluation of line integral, surface integral and volume integrals, Gauss's divergence theorem, Stoke's theorem (No Proof of these theorem), conservative force fields, scalar potential.

References:

1. R.K.Jain, S.R.K.Iyengar, Advanced Engineering Mathematics: Narosa Publishers.
2. C.R.Wilie & L.C.Barrett, Advanced Engineering Mathematics, Mc-Graw Hill
3. Larry C Andrews, Ronald C Philips, Mathematical Techniques for Engineers & Scientists, PHI Publishers
4. M.C.Potter, J.L.Goldberg, Advanced Engineering Mathemartics, Oxford Unversity Press.
5. B.S.Grewal, Higher Engineering Mathematics:, Khanna Publishers.

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT-1302 PHYSICAL CHEMISTRY

Module I

States of matter : Gaseous state: Gas laws and kinetic theory of gases, distribution of molecular velocities, mean free path. Real gases - non ideal behaviour, causes of deviation from ideal behaviour. Van der Waals equation, law of corresponding states, liquefaction of gases, Critical constants, cooling by expansion.

Liquid state: Surface tension and viscosity, Equilibrium vapour pressure and boiling point, optical and electrical properties, Refractive index, optical rotation, dipole moment, methods of determination relationship to molecular structure.

Solid State: Crystal structure, laws of crystallography, Bravais lattices, X-rays and crystal structure - Bragg's equation, packing of atoms. Bonding in solids, lattice defects, crystal energies.

Module II

Thermodynamic and Thermochemistry: Thermodynamic terms and basic concepts - formal statement of the first law of thermodynamics. Reversible changes, maximum work, heat capacity relationship. Heat reactions. C_p , C_v relationships, Kirchoff's equation, Hesse's law of summation. Experimental methods of determination of heats of reactions, heats of reaction and bond energies. Second law of thermodynamics: Spontaneous and non-spontaneous processes. Carnot cycle, entropy, free energy and work function,

Variation of free energy with temperature and pressure. Gibbs-Helmholtz equation, Free energy and equilibrium - Vant Hoff reaction isotherm and isochore, criteria for spontaneity, standard free energy changes. Third law of Thermodynamics - Nernst heat theorem, unattainability of zero on absolute temperature scale. Determination of entropy from thermal measurements.

Module III

Reaction kinetics : Reaction kinetics, catalysis and photochemistry kinetics, Significance of rate law and rate equation, order and molecularity, determination of order of simple reactions - experimental methods, equilibrium constant and reaction rate, theories of reaction rates - Lindemann, Collision and activated complex theories. Complex reactions of the first order Characteristics of consecutive, reversible and parallel reactions - steady state and nonsteady state approach.

Module IV

Catalysis and Photochemistry : Catalysis - Criteria for catalysis - Homogeneous catalysis - acid-base, enzymatic catalysis, catalysis by metal salts. Heterogeneous catalysis - concepts of promoters, inhibitors and poisoning, physisorption, chemisorption, surface area, industrially important processes, oxidation, cracking and reforming Photochemistry - quantum yield and photochemical equivalent, primary photo processes, typical photochemical reactions, photo-sensitization and photochemical equilibrium.

References:

1. Atkins P. W: "Physical Chemistry", Oxford University Press
2. Kapoor K.L. "Physical Chemistry" Vol. I & II, Macmillan, New Delhi
3. Peter Wastra: "Physical Chemistry of Foods"
4. Puri & Sharma " Physical Chemistry"
5. Soni PL. and Dharmala OP.: Text Book of Physical Chemistry, S. Chand & Sons
6. Tinea, Ignacio et al: "Physical Chemistry - Principles and Applications in Biological Sciences" 4th edition, Prentice Hall.

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1303 – ORGANIC CHEMISTRY

Module I

Electronic Theory :Types of bonds, bond fission processes, hybridization Reactive intermediates Generation, structure and general reactions of carbo cations, carbanions, free radicals and carbenes (single and triplet). Wagner-Meerwein rearrangement, Electrophiles and nucleophiles. Concepts of acids and bases. Bronsted theory, Lewis theory and Pearson's Classification (HSAB), Carbon acids (active methylene groups, super acids. Correlation of structure with acidity and basicity. Hyper conjugation: Concept and consequences. Field effect, Resonance effect - Resonance energy and its significance, (vertical and empirical resonance energy), Strains in acyclic compounds. IUPAC Nomenclature: Systematic IUPAC nomenclature of different classes of compounds including aromatic, bicyclic ;:lild spiro compounds and polyfunctional compounds.

Classification of stereoisomers, diastereoisomers, Separation of enantiomers. Absolute configuration (R and S). Projection formulae. Stereochemistry of compounds containing two asymmetric C-atoms, elements of symmetry - center, plane, axis of symmetry, Stereochemistry of biphenyls and spiro compounds, Conformations:

Conformations around a C-C bond in acyclic compounds, Structure of cycloalkanes, different Strains in cyclic compounds, Cyclohexane conformations, Stereochemistry of di substituted cyclohexanes. Geometrical isomerism - Concept, E and Z nomenclature, Stereoselective and specific Reactions, Introduction to asymmetric synthesis.

Module II

Hydrogen bonding :Bonds weaker than covalent bond: Hydrogen bonding - nature, types, stability and effects, van der Waals forces, Electron - donor acceptor complexes, Inclusion compounds. PII-dll bonding in organic compounds, ylids (S and P), witting reaction. Tautomerism: Cationotropy and anionotropy, Prototropic shifts in different systems, ring-chain tautomerism and valence tautomerism. Cope rearrangement.

Module III

Alkanes :Methods of preparation, source-petroleum and coal in brief, Cracking and reforming. Alkanes: Methods of preparation. Reactions: Hydrogenation, oxidation, hydroxylation, addition Markownikoff rule with explanation and peroxide effect, Dienes - types of dienes and their characteristic reactions, effect of conjugation on stability and reactivity, diels-alder reaction in detail with its stereochemistry. Polymerisation of olefinic compounds, Use and mechanism of Ziegler-Natta catalysis, Hydroboration reaction, Claisen rearrangement. Alkynes : Methods of preparation, Addition reactions. Alcohols: Methods of preparation, H-bonding in and general reactions. Use of peroxides in the preparation, Pinacol rearrangement.

Module IV

Aldehydes and ketones :Methods of preparation, 1,2-addition reactions of a carbonyl group, Activation of the position adjacent to carbonyl. The following reactions with mechanism and industrial applications: Aldol, Cannizzaro, Perkin, Knoevenagel, Reformatsky, Darzen, Claisen ester, Stobbe, Michael addition, Benzilic acid rearrangement. Mannich. Substitution at the α -position of a carbonyl group. Examples of syntheses involving active methylene group leading to C-C bond formation. Ethyl acetoacetate, diethyl malonate chemistry (reactions). Carboxylic acids and their derivatives: Preparation and general reactions. Carboxylic acids and their derivative : Preparation and general reactions. Haloalkanes: Methods of preparation, Nucleophilic substitution reactions, SN^1 and SN^2 reactions effect of structure, nucleophilicity, solvent and temperature on, use of crown ethers and PTC, SN_C , SN_i and SN^1 reactions. Walden inversion, Nonclassical carbenium ion. NGP involvement. Grignard reagent - Formation and reactions, umpolung principle. Reaction of alkyl halides with active metals to form organometallic compounds and general applications of organometallic compounds.

References:

1. *Bhal & Arun Bhal: "Advanced Organic Chemistry"*
2. *Bruckner, Reinhard: "Advanced Organic Chemistry: Reaction Mechanism", Academic Press.*
3. *Dugas Herman: "Bio-Organic Chemistry", Springer*
4. *Finar I.L. : "Organic Chemistry", Vall & "*
5. *Morrison and Boyd: "Organic Chemistry", Prentice Hall of India*

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1304 – MICROBIOLOGY

Module I

Introduction - Microbes-Structure And Multiplication: Basic of microbial existence; history of microbiology, classification and nomenclature of microorganism, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

Structural organization and multiplication of bacteria, viruses, algae and fungi with a special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophage.

Module II

Microbial Nutrition, Growth and Metabolism: Nutritional requirements of bacteria and different media used for bacterial culture; growth curve and different methods to quantitative bacterial growth, aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

Module III

Control Of Microorganisms: Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents, mode of action and resistance to antibiotics; clinically important microorganisms.

Module IV

Industrial And Environmental Microbiology :Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, vit.b-12; biogas; bioremediation; leaching of ores by microorganisms; bio fertilizers and bio pesticides; microorganisms and pollution control; biosensors

References:

1. Pelczar MJ, Chan ECS And Krein NR, *Microbiology, Tata McGraw Hill Edition, New Delhi, India*
2. Powar, G.B. and H.F. Dagainawala, "General Microbiology, Vol.1 and 11". Himalaya Publishing House, New Delhi, 1989.
3. Prescott LM, Harley JP, Klein DA, *Microbiology, 3'd Edition, Wm. C. Brown Publishers, 1996.*
4. Talaron K, Talaron A, Casita, Pelczar And Reid. *Foundations In Microbiology, W C. Brown Publishers, 1993.*
5. Rangaswami, G and D.J. Bagyaraj, "Agricultural Microbiology", Asia Publishing House, New Delhi, 1992.
6. Stanier, R. Y., J. Ingtaham, M. C. Wheelis, and PR. Painter, "The Microbial world" Prentice Hall, England, New Jersey, 1986.
7. Taurop, KK Kapoor and KS. Yadav, "An Introduction to microbiology. Wiley Publications, New Delhi, 1989.

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1305 – BIOCHEMISTRY & NUTRITION

Module I

Bio molecules - Structure And Properties : Types of bio molecules, chemical nature, biological role, Common Types Of Carbohydrates (Mono, di, oligo and polysaccharides) Lipids (fatty acids, glycerolipids, phospholipids, glycolipids, sphingolipids, steroids) Amino acids, peptides, proteins and conjugated proteins like Glycoproteins and lipoproteins Purines, pyrimidines, nucleosides, nucleotides.

Module II

Digestion and Absorption: Digestion and Absorption of carbohydrate, blood glucose regulation, Digestion and absorption of protein and fat, BMR, BMI Calculation.

Module III

Metabolism & Bioenergetics: Biosynthesis and breakdown of carbohydrates, lipids, proteins and nucleic acids, Metabolic path ways, TCA cycle, glycolysis, gluconeogenesis pentose phosphate shunt, Embden Meyerhof pathway, urea cycle, interconnection of pathways, metabolic regulation. High energy compounds, electronegative potential of compounds, Respiratory chain, TP cycle, calculation of ATP production during glycolysis and TCA and regulation of levels of high-energy compounds and reducing equivalents inside the cell.

Module IV

Vitamins Minerals & Water Balance :The Water soluble Vitamins: B vitamins examined individually (folate and 812) and in concert; B vitamin deficiencies, toxicities, and food sources; vitamin C roles and recommended intake, deficiency, toxicity and food sources.

The Fat soluble vitamins: A,D,E and K: Function, recommended intake, toxicities, food sources of vitamin A,D,E and K; vitamin E as antioxidant; beta carotene and vitamin A.

Water and Major Minerals: Water balance and recommended intakes; fluid/electrolyte balance, acid-base balance; function, recommended intakes, and regulation of sodium, potassium, and calcium.

References:

1. Albert, L. Lehninger et al, "Biochemistry", 5th edition Worth Publishing, 2000
2. Conn, E and P.K. Stump, "Outlines of Biochemistry", Willey Eastern Ltd., New Delhi, 1984.
3. David L. Nelson and Michael M Cox "Lehninger's Principles of Biochemistry", Macmillan Worth Publisher
4. Jain.J.L. "Fundamentals of Biochemistry", 14th Rev. Editin, S.Chand and Company, New Delhi, 1999.
5. Lehninger A.L., Nelson DL, Cox .M.M, "Principles of Biochemistry", CBS Publications, 1993.
6. Lubert Stryer, Biochemistry, 4th Edition, WH Freeman & Co., 2000.
7. 5 .. Murray, R.K., Granner, B.K., Mayes, PA., Rodwell. V. W, "Harper's Biochemistry", Prentice HallInternational/.
8. Voet and Voet, "Biochemistry", ~d Edition, John Wiley & Sons Inc., 1995.
9. Aurand, L. Wand Woods, AE., "Food Chemistry", A VI, Westport, 1973

10. *Baba Saheb and Desai B.: "Handbook of Nutrition and Diet"*
11. *Belitz H.D., Grosch W, Schieberle P, "Food Chemistry".*
12. *Birch, G.G., Cameron, AG., and Spencer, M. "Food Science", yd edition" Pergamon Press, New York. 1986*
13. *Fennema, o.R. "Principles of Food Science: Part-I Food Chemistry", Marcel Dekker, New York, Ed. 1976.*
14. *Meyer, L.H.: "Food Chemistry': East West Press Ltd., New Delhi, 1973*
15. *Michael J. Gibney, Ian A Macdonald and Helen M. Roche, "Nutrition and Metabolism", Blackwell Publishers NS*
16. *Potter, N.N.: "Food Science", A VI, Westport, 1978. Sanders, Tom and Emery, Peter: "Molecular Basis of Human Nutrition", Taylors Francis, 2003*

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1306 – THEORY OF MACHINES

Module I

Mechanisms: Basic concept of machines - Kinematics - links-pairs-chain-machines and mechanisms-Different mechanisms and users-Inversion of mechanisms - Four bar linkage-its inversions.

Module II

Friction – Friction, pivot and collar friction-bearing-types- Loss of power due to friction in bearings-Basic theory of lubrication-viscosity ratings-Antifriction bearings-types-brakes bank-shoe-clutches types-single and multiple disc cone and their applications.

Module III

Power Drives : Power drives- belt-flat and V belts-Tension ratio-centrifugal tension-creep-chain Drives-Gears-classification-terminology-profile-Law of gearing-minimum number of teeth interference between rack and pinion-efficiency-gear trains-simple-compound -reverted.

Module IV

Governors, Flywheels And Cams : Governor-watt and porter governor-sensitivity and hunting, flywheel-function - fluctuation of speed and energy. Cam and follower-types-application-profiles fro uniform velocity and acceleration simple harmonic and cycloidal motion - uniform angular velocity.

References:

1. Rattan, S.S. "Theory of Machines", Tata McGrawHili Publishing Company Ltd., New Delhi.
2. Khurni, R.S. and Gupta, J.K. "Theory of Machines", Eurasia Publishing House Calcutta, 1994.
3. Shigley. J.E. & Nicker.J.J., "Theory of Machines and Mechanisms:., end Edition, McGrawHillInc., 1995.
4. Ghosh A & Malik A.K., "Theory of Mechanisms and Machines", Affiliated East West Press (P) Ltd., 1998.
5. Ballaney, P.L., "Theory of Machines", Khanna Publishers, New Delhi 1994.

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 13L1 – MICRO BIOLOGY LAB

1. Laboratory safety and sterilization techniques
2. Microscopic methods in the identification of microorganisms
3. Preparation of culture media - nutrient broth and nutrient agar
4. Culturing of microorganisms - in broth and in plates (pour plates, streak plates, isolation and preservation of bacterial cultures)
5. Staining techniques - grams' and differential
6. Quantitation of microorganisms.
7. Effect of disinfectants on microbial flora
8. Antibiotic sensitivity assay
9. Growth curve - observation and growth characteristics of bacteria and yeast.
10. Effect of different parameters on bacterial growth (ph, temperature & UV irradiation)

Note : 50% marks is earmarked for continuous evaluation and 50%marks for end semester examination to be assessed by two examiners. The candidate shall secure a minimum of 50% in the aggregate and 50% minimum in the end semester examination for a pass.

FT 13L2 – PHYSICAL AND ORGANIC CHEMISTRY LAB

1. Determination of Heat of ionization / Neutralization of acids.
2. Determination of rate constants and activation energy of simple first and second order reactions.
3. General acid catalyzed reactions - Catalytic coefficients and Dissociation Constants.
4. Determination of molecular weight of substances.
5. Experiments based on the principles of Electrochemistry. Applications of Thermodynamic principles and Surface Chemistry.
6. Systematic qualitative analysis of organic compounds by solubility , elemental analysis, group detection, physical constant and derivatization
7. Estimation of selected organic compounds such as aniline / phenol, formaldehyde/ acetone, glucose, glycerol.
8. Neutral equivalence of acids and bases and estimations of the following functions groups-amide, ester, acid, amino nitro.
9. Separation and purification of binary mixtures of the type: water soluble water insoluble - water insoluble, liquid-solid and liquid-liquid.
10. Preparation of simple organic compounds involving importance unit operations.

References:

1. Shoemaker, D.P., Garland C. Wand Niber J. W, "Experiments in Physical Chemistry", 5th edition, McGraw Hill, 1989.
2. Vogets Textbook of Practical Organic Chemistry 5th edition, ELBS Longman, 1989

Note : 50% marks is earmarked for continuous evaluation and 50%marks for end semester examination to be assessed by two examiners. The candidate shall secure a minimum of 50% in the aggregate and 50% minimum in the end semester examination for a pass.

SEMESTER IV

FT 1401 ENGINEERING MATHEMATICS III

Module 1

Complex Analytic functions and conformal mapping: curves and regions in the complex plane, complex functions, limit, derivative, analytic function, Cauchy – Riemann equations, Elementary complex functions such as powers, exponential function, logarithmic, trigonometric and hyperbolic functions.

Conformal mapping: Linear fractional transformations, mapping by elementary function like Z^2 , e^z , $\sin z$, $\cos z$, $\sin hz$, and $\cos hz$, $Z + 1/Z$

Module II

Complex integration: Line integral, Cauchy's integral theorem, Cauchy's integral formula, Taylor's series, Laurent's series, residue theorem, evaluation of real integrals using integration around unit circle, around the semi circle, integrating contours having poles, on the real axis.

Module III

Partial differential equations:

Formulation of partial differential equations.

Solutions of equations of the form $F(p,q) = 0$, $F(x,p,q) = 0$, $F(y,p,q) = 0$, $F(z,p,q) = 0$ $F_1(x,p) = F_2(y,q)$, Lagrange's form $Pp+Qq = R$

Linear homogeneous partial differential equations with constant co-efficient

Module IV

Vibrating string: one dimensional wave equation, D'Alembert's solution, solution by the method of separation of variables

One dimensional heat equation, solution of the equation by the method of separation of variables,

Solutions of Laplace's equation over a rectangular region and a circular region by the method of separation of variables.

References:

1. R.K.Jain, S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa Publishers.
2. C.R.Wilie and L.C.Barrett Advanced Engineering Mathematics, Mc-Graw Hill.
3. Erwin Kreyszig, Advanced Engineering Mathematics, Wilsey Eastern.
4. Churchill R.V, Complex Variables & Applications, Mc-Graw Hill.
5. M.C.Potter, J.L.Goldberg. Advanced Engineering Mathematics, Oxford University Press.
6. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers.

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1402 – PRINCIPLES OF CHEMICAL ENGINEERING

Module I

Material Balances : Mass and energy conservation; process automation; environment; SI units; conservation factors; applied mathematics for experimental curve fitting; numerical differentiation; integration. Overall and component balances; material balances without and with chemical reactions; degrees of freedom; steady and unsteady state; unit operations; recycle and by pass; humidity calculations.

Module II

First and Second Laws Of Thermodynamics : Energy balances; sensible heat, latent heat; vapour pressure; steady and unsteady state calculations.

Module III

Fluid Mechanics : Fluids; fluid statics and applications in chemical engineering; fluid flow; laminar; turbulent pressure drops; compressible fluid flow concepts; multiphase flow concepts.

Module IV

Flow Through Packed Columns: Fluidisation; centrifugal and piston pumps; characteristics; compressors; turbo compressor work.

References:

1. Bhatt B.I., Vora S.M. "Stoichiometry".3'd Edition. Tata McGraw-Hili, 1977.
2. McCabe w.L., Smith J.C, Harriot P. Unit Operations In Chemical Engineering. 5/11 Edition. McGraw-Hili Inc., 1993.
3. Geankoplis C.J. Transport Processes And Unit Operations. Prentice Hall India, 2002.

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1403 – HEAT AND MASS TRANSFER

Module I

Mass and Heat transfer :Molecular diffusion in fluids and solids; Interphase Mass Transfer; Mass Transfer coefficients; Analogies in Transport Phenomenon.

Mechanism of heat transfer by conduction, convection and radiation. Concept of individual and overall heat transfer coefficient.

Module II

Gas liquid operations : Principles of gas absorption; Single and Multi component absorption; absorption with Chemical Reaction; Design principles of absorbers; Industrial absorbers NTU HTU concepts.

Module III

Vapour liquid operations : V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCABE-THIELE Principles; Industrial distillation equipments, HETP, HTU and NTU concepts.

Module IV

Extraction operations : L-L equilibria, Staged and continuous extraction, Solid-liquid equilibria, Leaching Principles.

References:

1. Geankoplis c.J. "Transport Processes and Unit Operations" 3rd edition Prentice Hall of India, 2002.
2. Treybal R. E.: "Mass Transfer Operations" 3rd edition. Mcgraw Hill, 1981.
3. Coulson and Richardson's Chemical Engineering. Vol I & II, Asiali Books Pvt ltd,1998

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1404 – UNIT OPERATIONS IN FOOD PROCESSING

Module I

Mixing and Aeration: Dimensional analysis; power for agitation; agitation of liquids; gas-liquid systems; gas-solid suspensions; agitator scale up.

Constant pressure, constant volume batch filtration; continuous filtration; industrial filters; settling and sedimentation; centrifugation.

Module II

Heat transfer equipments : Applications of the principles of heat transfer to design equipment such as heat exchangers, condensers, jacketed kettles and coils, reboilers. Evaporation. Refrigeration. Drop wise and film wise condensation. Boiling. Unsteady state heat transfer. Heat transfer media.

Module III

Crystallization : Characteristics of crystals like purity, size, shape, geometry, habit forms, size and factors affecting them, solubility curves and calculation of yields. Supersaturation theory and its limitations, . Mier's supersolubility curve, nucleation mechanisms, crystal growth, study of various types of crystallizers, tanks, agitated batch, Swenson Walker, single vacuum, circulating magma and Krystal crystallizer. Caking of crystals and its prevention. Numerical problems on yields.

Module IV

Drying : Moisture content and mechanism of drying, rate of drying and time of drying, calculations, classification and types of dryers, dryers used in industries and special drying methods - tray, fluidized bed, spray, freeze, tunnel, Microwave, IR dryers. Mathematical problem on drying.

References:

1. *Geankoplis C.J.: "Transport Processes And Unit Operations". Prentice Hall India. 2002.*
2. *McCabe WL., Smith J.C.: "Unit Operations In Chemical Engineering". 5th edition,*
3. *McGrawhill.1993.*
4. *Earle R.L., "Unit operations in Food Processing", Pergamon Press.*
5. *Charm S.E., "Fundamentals of Food Engineering", AVI Publishing Com'pany*
6. *Sahay, KM and Singh KK "Unit Operations of Agricultural Processing", Vikas PUBLISHING House.*
7. *In crop era FP. Fundamentals Of Heat And Mass Transfer. John Wiley. 1998.*

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1405 – REFRIGERATION AND COLD CHAIN

Module I

Refrigeration Theory : Basic methods of refrigeration - Air vapor compression and vapor absorption refrigeration systems - components of a vapor compression system .

Theories and methods of chilling and freezing. Temperature-Time graph of freezing process. Relation between air velocity and freezing time, calculation of freezing time. Heat velocity of foods, relationship between moisture content and time. Drying during constant and falling during the above periods. Refrigeration load in freezers.

Module II

Food Refrigeration :Processing, storage and distribution of chilled and frozen foods such as meat, poultry, fish, eggs, dairy products, beverages, fruits, vegetables, fruit juice" concentrates and bakery products. Pre-cooling of foodstuffs - methods, equipment, calculation of time, refrigeration load recommended, conditions for storage etc.

Module III

Refrigerated storage : Factors of importance in refrigerated storage. Food storage requirement Cold storages and frozen storages. Design of cold storage and frozen stores. Controlled environment storage for food products and vapour barriers for cold stores. Refrigerated warehouse, refrigerated trucks, trailers and containers. Railway refrigerated cars, marine refrigeration, refrigeration in air transport.

Module IV

Effect of refrigeration on food : Freezing characteristics of foods, factors affecting the quality of frozen foods., Microbial activity at low temperature. Analysis & Indications. Packaging requirements for frozen foods, effect of freezing on constituents of foods. Hazard analysis and Thaw indicators,

References:

1. Dossat, "*Principles of Refrigeration*"
2. Gosney W, "*Principles of Refrigeration*", Cambridge University Press, 1982
3. Gunteer R. C., "*Refrigeration, Airconditioning and Cold Storage*," Chuition Book Co., Pennsylvania, 1969.
4. Leniger H.A, and Everloo W.A, "*Food Process Engineering*", O. Reidal Publishing Co., 1975
5. Joselyn M.A, and Heid J.L., "*Food Processing Operations*", Vol. 1 to 3, The Air Publishing Co., 1964
6. Ryall AL. and Lipton W.J. Handling, " *Transportation and Storage of Fruits and Vegetables*", The Air Publishing Co., 1972.
7. Van Arsdel WE. and Copley M.J., "*Freezing Preservation of Foods*" Vol. 1 to 4, The Air Publishing Co. 1968.

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1406 – FOOD MICRO BIOLOGY

Module I

Micro organisms and their control : Introduction to Microbiology and its applications. Microscopic study of bacteria yeast moulds, viruses, with respect to morphology, reproduction growth requirements. Isolation, preservation and maintenance of pure cultures. Enumeration of Microorganisms. Growth curve. Mutation. Introduction to genetics. Method of sterilization, disinfection, sanitation. Principles of immunology.

Module II

Food spoilage : Factors affecting spoilage of foods, Micro flora associated with various food groups, their spoilage potential and control. Microbiological spoilage problems associated with typical food products.

Module III

Food supply and standards: Food borne infections and food poisoning, Microbial toxins, Newer pathogens. Microbial quality assurance systems in food industry, HACCP food standards, Rapid methods of microbial analysis.

Module IV

Detection and use of microbes in foods : Applications of immunological, techniques to food industry; Detection methods for *E coli*, *Staphylococci*, *Yersinia*, *Campylobacter*, *B.cereus*, *Cl. Botlimum* & *Salmonella* from food samples; Examples of microbes in manufacture of important food ingredients. Food fermentation.

References:

1. Adams NR. and K. O. Moss: "Food Microbiology", New Agent International Pvt. Ltd., 1995.
2. Frazier we. & Westhorff D.C.: "Food Microbiology", McGraw Hill, 2000
3. Jay G.M.: "Food Microbiology", 4th edition, CBS Publishers, 2003
4. James M. Jay, "Modem Food Microbiology", CBS Publishers & Distributors, New Delhi.
5. Michael P.' Doyle, Larry R Beuchat and Thomas J. Montville : "Food Microbiology - Fundamentals and Frontiers, 'Z"d edition, ASM Press, 2001.
6. Parry T.J. and Pawsay R.K.: "Principles of Microbiology for Food Technology students': 'Z"d edition, Hutchinson, 1984.
7. Thomas J. Montville & Karl R. Mathews, "Food Bicrobiology - An Introdition", ASM Press, Washington
8. William C. Frazier & Dennis C. Westhoff, "Food Microbiology"

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 14L1 – FOOD MICRO BIOLOGY LAB

1. Microbiological assays of growth factors.
2. Evaluation of microbiological quality of potable water, milk and selected food products involving total, viable and coli form count Counting for yeasts and moulds
3. Testing for Salmonella, fecal Streptococci & Staphylococci
4. Use of microorganisms in food preservation,
5. Standard plate count of milk
6. Factors affecting microbial growth and preservation of foods
7. Food safety in the home
8. Environmental sampling Yeasts and moulds and canned foods
9. Isolation and identification of *Vibrio spp*
10. Special project: Microbial Analysis I Isolation.

Note : 50% marks is earmarked for continuous evaluation and 50%marks for end semester examination to be assessed by two examiners. The candidate shall secure a minimum of 50% in the aggregate and 50% minimum in the end semester examination for a pass.

FT 14L2 – UNIT OPERATIONS LAB

1. Flow measurement
2. Pressure drop in piped and packed columns
3. Fluidization
4. Filtration
5. Heat exchanger
6. Simple and steam distillation
7. Distillation in packed column
8. Liquid-liquid Equilibria in extraction
9. Adsorption equilibrium
10. Drying characteristics
11. Gas absorption
12. Study of agitated vessels.

Note : 50% marks is earmarked for continuous evaluation and 50%marks for end semester examination to be assessed by two examiners. The candidate shall secure a minimum of 50% in the aggregate and 50% minimum in the end semester examination for a pass.

SEMESTER V

FT 1501 ENGINEERING MATHEMATICS IV

MODULE 1

Probability distributions: random variables (discrete & continuous), Probability density, mathematical expectation, mean and variance of a probability distribution, binomial distribution, Poisson approximation to the binomial distribution, uniform distribution, normal distribution.

Curve fitting: method of least squares, correlation and regression, lines of regression.

Module II

Sampling distributions: Population and samples, the sampling distribution of the mean unknown (σ known), the sampling distribution of the mean (σ) the sampling distribution of the variance, point estimation, interval estimation, tests of hypotheses, null hypotheses and significance tests, hypothesis concerning one mean, type I and type II errors, hypotheses concerning two means. The estimation of variances: Hypotheses concerning one variance – Hypotheses concerning two variances.

Module III

Finite difference Operators: ∇ , Δ , E , δ , μ , $x^{(n)}$

Newton's Forward and Backward differences interpolation polynomials, central differences, Stirlings central differences interpolation polynomial. Lagrange interpolation polynomial, divided differences, Newton's divided differences interpolation polynomial.

Numerical differentiation: Trapezoidal and Simpson's rules, compounded rules, errors of interpolation and integration formulae. Gauss quadrature formulae (No derivation for 2 point and 3 point formulae)

Module IV

Numerical solutions of ordinary differential equations: Taylor series method, Euler's method, modified Euler's method, Runge-Kutta formulae 4th order formula,

Numerical solution of boundary value problems: Methods of finite differences, finite difference methods for solving Laplace's equation in a rectangular region, finite differences methods for solving the wave equation and heat equation.

References:

1. Irvin Miller & Freund, Probability And Statistics For Engineers, Prentice Hall of India.
2. S.S.Sastry, Numerical Methods, PHI Publishers.
3. P.Kandaswamy.K.Thilagavathy, K.Gunavathy, Numerical Methods, S.Chand & Co.
4. A.Papoulis, Probability, Random Variables and Stochastic Processes, Mc-Graw Hill.

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1502 – FOOD CHEMISTRY & ADDITIVES

Module I

Introduction to food chemistry definition, proximate composition food groups, functions of various group, water, forms of water in food, water activity measurement, chemistry of starch, cellulose, lignin, pectin, gums.

Module II

Chemistry & Functions of Protein Fat Amino Acid Chemical score protein quality methods changes of proteins and fat on storage with special emphasis on enzymatic changes and fat oxidation

Module III

Additives in food processing and preservation. Their functions and safety. Preservatives, anti oxidants, colours with respect to chemistry, food uses and functions in formulations

Module IV

Flavours, Emulsifiers, sequestrants with respect to chemistry, food uses and functions in formulations. Polyols, Stabilizers, sweeteners, acidulants, with respect to chemistry, food uses and functions in formulations.

References:

1. Alexander, R.J. 1998. *Sweeteners: Nutritive*. St. Paul, MN: Eagan Press.
2. Cremer, M.L. 1998. *Quality Food in Quantity. Management and science*. Berkely C.A: McCutchan Publishing Company
3. Ensminger, AH., ME. Ensminger, J.E. Konlande and J.R. Robson, 1983. *Foods and Nutrition Encyclopaedia 2 Vols*. Clovis, C.A: Pegasus Press
4. Francis F.J. 1998, *Colorants*. St. Paul, MN: Eagan Press
5. Stauffer C.E. 1999. *Emulsifiers*. St. Paul, MN.: Eagan Press.
6. Thomas O.J. and WA Atwell. 1999 *Starches*. St. Paul, MN.: Eagan Press

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1503 – FOOD PROCESS ENGINEERING

Module I

Introduction - Processing Methods :Scope and importance of food processing - National and international perspective sensory characteristics and nutritional properties of food - Texture, taste, flavour and aroma, Geometric, physical and functional property of food raw material preparation for food processing - Energy conservation - Material and energy balance - Problems.

Heating - Blanching and Pasteurization. Freezing - Dehydration - canning additives fermentation - extrusion cooking - hydrostatic pressure cooking dielectric heating - micro wave processing and aseptic processing - Infra red radiation processing - Concepts and equipment used.

Module II

Drying : Moisture content - definition, methods of determination - direct and indirect methods. Equilibrium moisture content - Hysteresis effect - Psychrometry properties of air, water -vapour mixer, problems in psychrometry. Drying mechanisms - constant rate period and falling rate period - methods and equipment used - factors affecting rate of drying.

Module III

Food Conversion operation : Size reduction - Fibrous foods, dry foods and liquid foods - Theory and equipments - membrane separation - filtration - equipment and application.

Module IV

Material Handling :Material handling - types of handling and conveying system for food products and their design - Belt conveyor, screw conveyor, bucket elevator and pneumatic conveyor.

References:

1. B. Sivasankar. 2002. *Food processing and preservation. Prentice Hall of India Pvt. Ltd., New Delhi -110 001*
2. P. Fellow. 1998. *Food Processing Technology. Principles and practice. Ellis Horwood International publishers, Chichester, England.*
3. *Unit operations in Agricultural Processing by Sahay and Singh.*

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1504 – PRINCIPLES OF FOOD PROCESSING AND PRESERVATION

Module I

Preservation by removal of heat: Considerations relating to storage of foods at chilling temperature, applications and procedures, controlled and modified atmosphere storage of foods. Freezing temperature : Freezing process, slow and fast freezing of foods and its consequences, other occurrences associated with freezing of foods. Technological aspects of pre-freezing, Actual freezing, frozen storage and thawing of foods, freeze drying, cryo preservation.

Module II

Preservation by addition of heat : Basic concepts in thermal destruction of micro-organisms-D, Z, F, values Heat resistance and thermophilisms in micro-organisms. Cooking, blanching, pasteurization and sterilization of foods. Extrusion, baking, roasting, frying, dielectric heating, ohmic, microwave and infrared heating. Assessing adequacy of thermal processing of foods, general process of canning of foods, spoilages in canned foods.

Module III

Preservation by water removal: Sun drying of various foods, water activity and its effect on the keeping quality, sorption isotherms and their use. Characteristics of food substances related to their dehydration behavior, drying phenomenon, factors affecting rate of drying, methods of drying of various food products, type of drier and their suitability for different foods- intermediate moisture foods.

Module IV

Radiations : Sources of radiations, units and does, effect on micro organisms and different nutrients; dose requirements issues, irradiation mechanism and survival curve, irradiation of packaging materials.

References:

1. *Principles of Food Science-Part-II : Physical Method of Food Preservation* by M. Karel, O.R. Fennema and D.B. Lund, Marcel Dekkar Inc.
2. *Principles of Food Preservation* by V. Kyzlink, Elsevier Press.
3. *Modern Food Microbiology* by James M.Jay, D.Van Nostrand

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1505 – FOOD PROCESS EQUIPMENTS & DESIGN

Module I

Milling and Extrusion Equipments: Milling equipments used for rice and wheat, pearling and flaking equipment; dhal mills; Extrusion processing: principles; different types and design of extruders

Module II

Washing, Filtration & Centrifugation Equipments: Different Fruits and Vegetable washing systems; Conveyor belts - types, material of construction, product specific conveyors; Design of screw, bucket, belt, oscillating and vibratory conveyors; filtration of liquid foods (dairy, fruit & vegetables); centrifugation systems: Solid bowl and disc bowl centrifuges; cyclone separator and self cleaning centrifuge.

Module III

Mixing, Blending & Filling Equipments: Agitation and mixing of liquid foods, powders and pastes; Mixers - ribbon blenders, augur, nauta, cone.

Liquid and powder filling machines - like aseptic system, form and fill (volumetric and gravimetric), bottling machines.

Module IV

Heat Processing and Cooling Equipments: Autoclaves - types, operation; Different drying systems - Spray, Fluidized bed, tunnel; evaporators; pasteurizers, steamer, roaster ovens, kettles, baking & confectionery equipments

Freezing equipments - Plate, Tunnel, blast, IQF, Liquid nitrogen, Heat exchangers - Tubular and Plate; Refrigerated transport and transportation in insulated containers,

References:

1. Lopez – Gomez, A. and Barbosa – Canovas, G.V. “Food Plant Design”, Taylor & Francis, 2005.
2. Smith, P.G. “Introduction to Food Process Engineering”, Springer, 2005.
3. Rao, M.A. S.S.H. Rizvi and A.K. Datta, “Engineering Properties of Food”, 3rd Edition, Taylor & Francis, 2005.
4. “Food and Bio Process Engineering” Anamaya Publishers, 2005.

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1506 – FOOD ANALYSIS

Module I

Introduction : Introduction, Government regulations, Sampling, Moisture and total solids, proximate composition, Ash analysis.

Module II

Spectroscopy and Chromatography : Spectroscopy principles, Spectroscopy: visible, UV, Fluorescence, spectroscopy: atomic absorption and emission, Mass Spectrometry,

Chromatography principles, Column chromatography, Thin layer chromatography, Gas liquid chromatography, High performance liquid chromatography, supercritical fluid chromatography

Module III

Electrophoresis : Electrophoresis Isoelectric focusing, capillary electrophoresis, Immunoassay 1- Principles, Immunoassay, Thermal Analysis.

Module IV

Protein Analysis :Protein analysis, Protein quality analysis, Lipid analysis, Carbohydrate analysis, analysis of extraneous matter, Ion sensitive electrodes and high performance sensors, Dry reagent chemistry (reagent strip chemistry)

References:

1. Nielsen S. S.: "Food Analysis", 2nd edition, Aspen Publishing, 1998 Water Analysis Handbook, 4th edition, HACH 2002.
2. Semib Ot/es, "Methods of Analysis of Food Components and Additives", Ege University Publishers - Taylor & Francis, London, Singapore.
3. Leo M.L. Nollet: Handbook of Food Analysis Vols. I and /I
4. Joselyn, M.A., "Methods in Food Analysis': Academic Press, New York, 1970
5. King RD. "Developments in Food Analysis Techniques-1" Applied Science Publishers Ltd., London, 1978
6. Raghuramulu, N, Madhavan Nair, K and Kalyanasundaram, s. "A Manual of Laboratory Techniques': National Institute of Nutririon, ICMR, Hyderabad

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 15L1 – FOOD ANALYSIS LAB

1. Determination of starch and pectin substance.
2. Identification of sugars in fruit juices.
3. Analysis of physical properties of milk
4. Determination of free fatty acids
5. Experiments on estimation of anti nutritional factor
6. Determination of Food additives in food.
7. Deduction of adulteration in food
8. Experiments on fat tests.
9. Determination of amino acids.
10. Determination of crude fibre, minerals
11. Determination of ascorbic acid.
12. Experiments on water test.

***Note :** 50% marks is earmarked for continuous evaluation and 50%marks for end semester examination to be assessed by two examiners. The candidate shall secure a minimum of 50% in the aggregate and 50% minimum in the end semester examination for a pass.*

FT 15L2 – FOOD CHEMISTRY & BIOCHEMISTRY LAB

1. General guidelines for working in biochemistry lab (theory)
2. Accuracy, precision, sensitivity and specificity (theory)
3. Qualitative tests for carbohydrates & proteins - distinguishing reducing from non-reducing sugars and keto from aldo sugars .
4. Quantitative method for amino acids estimation using ninhydrin - distinguishing amino from imino acid.
5. Quantitative estimation by Carbohydrates
6. Protein estimation by Biuret and Lowry's methods
7. Protein estimation by Bradford and spectroscopic methods
8. Extraction of lipids and analysis by TLC
9. Estimation of nucleic acids by absorbance
10. Enzymatic assay: phosphatase from potato
11. Enzymatic assay: estimation of glucose by TGO method After hydrolysis of starch with acid and specificity of the enzymatic method.
12. Enzyme kinetics & immobilization studies.

Note : 50% marks is earmarked for continuous evaluation and 50%marks for end semester examination to be assessed by two examiners. The candidate shall secure a minimum of 50% in the aggregate and 50% minimum in the end semester examination for a pass.

SEMESTER VI

FT 1601 -FRUIT AND VEGETABLE PROCESSING

Module I

Introduction - General Procedures :General Introduction - Importance of fruits and vegetables in world agriculture Processing planning - location - Processing systems - Choice of processing technologies - Fruits and vegetables - global marketing view - General properties of fruits and vegetables - chemical composition and nutritional aspects - structural features - Auxiliary raw materials - Water - Sweeteners - Salt - Food acids - Pectin preparation - Intensive sweeteners.

Procedures for fruit and vegetable preservation-Fresh storage-Preservation by reduction of water content : drying / dehydration and concentration - Chemical preservation preservation of vegetables by acidification, preservation with sugar. Heat preservation/heat processing - Food irradiation - Combined preservation techniques.

Module II

Fruit Specific preservation technologies : Harvesting and preprocessing - Fresh fruit storage - Fruit drying and dehydration technology - Technology of semi-processed fruit products - Fruit sugar preserves technology - Banana and plantain processing technologies - mango and guava processing technologies - application of packaging and Modified Atmosphere to Fresh-cut Fruits and Vegetables, Fruit quality - Quality Parameters of Fresh-cut fruit products - Safety Aspects of Fresh-cut Fruits.

Module III

Vegetables specific processing technologies : Vegetables varieties - Harvesting and pre-processing - Fresh vegetable storage Vegetable drying/dehydration - vegetable juices and concentrated products - pickles and sauerkraut technology - Vegetable canning, Quality Parameters of Fresh-cut vegetable Safety Aspects of Fresh-cut vegetables- Evaluating sensory quality of fresh-cut fruits and vegetables.

Module IV

Deterioration factors and their control :Enzymic changes-economical losses by enzymatic browning-Enzymatic Effects on Flavor and Texture of Fresh-cut Fruits and Vegetables - types of deterioration in fruits and vegetables-preventive measures against deterioration-Methods of reducing deterioration traditional methods and modern method.

References:

1. *Mircea Enachescu Dauthy, "Fruit and Vegetable Processing" FAO Agricultural Services Bulletin no. 119, 1995.*
2. *Desrosier, N.W." The Technology of Food preservation CBS publishers, 1987. Reference books*
3. *Srivastava, Rand Sanjeev Kumar "Fruit and Vegetable Preservation", Principles and practices International Book Distributing Co., 1998.*
4. *Suman Bhatti, Uma Varma 'Gruit and Vegetable Processing", CBS Publishers.*
5. *PH. Pandey, "Post Harvest Technology of Fruits and Vegetables", Saroj Prakashan, Allahabad.*
6. *P.J. Fellows, "Food Processing Technology Principles and Practice", Woodhead Publishing Limited, England.*

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1602 -DAIRY PLANT ENGINEERING

Module I

Pasteurization :Milk-properties-reception and storage-cooling of milk - Different types of coolers and cooling systems. Pasteurization - principles, objectives and methods. LTLT/holding pasteurization-types, advantages and disadvantages. HTST pasteurization-components and function of HTST pasteurizer, advantages and disadvantages - Milk flow diagram - regeneration of heat. UHT pasteurization vacreation.

Module II

Sterilization and Homogenization :Sterilization-Inbotytle sterilization, UHT processing, Indirect heating systems using plate heat exchanges, Direct heating - Fouling of heat exchangers. Homogenization theory, effect Gf homogenization of milk-Homogenizer components valves. Pumps - functions and efficiency of process-operation and maintenance. Types of homogenizers-stages of homogenization-importance.

Module III

Centrifugation and membrane separation: Centrifugation-clarification-clarifiers and separators-separation efficiency-factors affecting fat percentage in cream-fat loss in skim milk. Construction of separatorcomponents-bactofuge treatment. Ultra filtration - Reverse osmosis process - Electro dialysis.

Module IV

Manufacture of dairy products: Butter manufacture - methods-cheese manufacture-methods. Skimmed milk powder Drum dryer-spray dryer-construction, powder recovery systems agglomeration. Ice-cream manufacture-over-run-types of freezers. Cleaning-basic principles-can washing-can wahers-cleaning-in-centralise and decentralized CIP system - cleaning of various equipment-corrosion control.

References:

1. Tufail Ahmed, "Dairy Plant Engineering and Management", CBS Publishers and Distributors, New Delhi, 2001.
2. De Sumumar, "Outlines of Diary Technology", Oxford University Press, New Delhi 1999.
3. Ananthkrishnan. C.P. and M.N. Sinha, "Technology and Engineering of Dairy Plant Operations", Laxmi Publications, New Delhi, 1997.
4. Farrall. A.W., "Engineering for Dairy and Food Products", John Wiley and Sons, New York, 1995.
5. Robinson R.K., "Modern Dairy Technology Vol. 1 "Advances in Milk Processing", Elsevier Applied Science Publishers, London, 1996.

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1603 – CEREALS, PULSES AND OILSEEDS PROCESSING

Module I

Rice processing :Rice - Variety - Consumption - nutritive value - distribution of nutrient within the grain - parboiling of paddy - merits and demerits of parboiling paddy - traditional methods - unit operations involved in parboiling - CFTRI method, Pressure parboiling, dry heat parboiling - advantage of modern methods. Cleaner and grader - cylindrical separator, spiral separator, colour sorter, inclined belt separator.

Dehusking of paddy - traditional methods - Engleberg huller - , under run disc sheller - merits and demerits of traditional methods.. Modern methods of dehusking paddy, rubber roll sheller, centrifugal dehusker. Polishing of rice friction and abrasion type polisher - Grading of rice - Layout of modern rice mills - processed products from rice - storage of rice and paddy - By product utilization from rice mill.

Module II

Wheat and Coarse Cereals Products: Wheat milling - types - tempering, break and reduction roll, purifiers and sifters, flour blending, corn milling- wet milling, dry milling, high fructose corn syrup, corn starch - oats processing - Extruded products Soybean and Minor Millet processing

Module III

Pulse processing : Types of legumes and pulses - chemical composition, pre-treatment of pulses commercial methods of dehulling - dry and wet grinding of pulses - machinery used for dhal milling - roasting and parching of pulses - processed products of pulses.

Module IV

Oil Seed processing : Groundnut, Mustard, Soybean, Sunflower, Safflower, Sesame and other oil bearing materials. Solvent Extraction Clarification, degumming, neutralization, bleaching, deodorization techniques/process. Belding of oils. Hydrogenation, Fractionation, Winterization.

References:

1. Kent Jones, "Cereal Technology"
2. Kent, "Technology of Cereals" Reference Books
3. Brooker, "Theory of Cereal Grains"
4. Altschule A.M., "Processed protein food stuffs"
5. Bailey A.E., "Cotton seed and cotton seed products"
6. Williams and Devine J., "The chemistry and Technology of edible oils and fats".

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1604 – FOOD PRODUCT DESIGN AND DEVELOPMENT

Module I

Designing New products: Market survey and its importance in; designing a questionnaire to find consumer needs for a product or a concept New Food Product Development (NPD) process and activities, NPD success factors, new product design, food innovation case studies, market-oriented NPD methodologies, organization for successful NPD; Recipe Development; use of traditional recipe and modification; recent developments in food ingredients/additives flavourings, colourings, emulsifiers, stabilizer and sweeteners; involvement of consumers, chefs and recipe experts; selection of materials/ingredients for specific purposes; modifications for production on large scale, cost effectiveness, nutritional needs or uniqueness; use of novel food ingredients and novel processing technologies.

Module II

Standardization & large scale production: Process design, equipment needed and Design; establishing process parameters for optimum quality; Sensory Evaluation; Lab requirements; different techniques and tests; statistical analysis; application in product development and comparison of market samples; stages of the integration of market and sensory analysis.

Module III

Quality, safety & regulatory aspects:Product Stability; evaluation of shelf life; changes in sensory attributes and effects of environmental conditions; accelerated shelf life determination; developing packaging systems for maximum stability and cost effectiveness; interaction of package with food; Regulatory Aspects; whether standard product and conformation to standards; Approval for Proprietary Product.

Module IV

Advertisement, Marketing & Case studies: Product performance testing; market positioning, Marketing: developing test market strategies; various tools and methodologies to evaluate consumer attitudes, preferences and market acceptance factors; Case Studies of some successes and failures- Factors that influence NPD success, innovation case studies to highlight best practice in terms of the integration of technological and marketing approaches to NPD; food choice models and new product trends.

References:

1. Gupta, Rahul “Food Retailing: Emerging Trends”, ICFAI University, Press, 2005.
2. Phani Madhav, T. “Food Industry and Health Concerns: Trends and Cases”, ICFAI University Press, 2005.
3. Chakraborty, Amrita “Food Processing: Opportunities and Challenges”, ICFAI University Press, 2006.
4. Brody, Aarn L. and John B. Lord “Developing new Food Products for a Changing Marketplace”, 2nd Edition, CRC/Taylor & Francis, 2008.
5. Food product development: Maximising success: M Earle, R Earle, and A Anderson, Woodhead Publ., 2001
6. New Food Product Development: From Concept to Marketplace, GW Fuller, CRC 2004
7. Sensory & Consumer Research in Food Product Design & Development, Moskowitz, Beckley and Resurreccion, Wiley-Blackwell 2006
8. Guidelines for Sensory Analysis in Food Product Development and Quality Control: Carpenter, Lyon & Hasdell, Springer 2000.
9. Developing New Food Products for a Changing Marketplace: Brody & Lord, CRC 2007

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1605 – FOOD PLANT LAYOUT & DESIGN

Module I

Layout features : Introduction to plant design- special features of food process industry- types of processing machineries- manufacturing processes-concept-types-special features for fruit, vegetable, bakery & milk products

Module II

Plant location : Plant location, location theory and models-plant site selection- estimation of series peak and critical load - Economic plant size-plant layout objectives-classical and practical layout.

Module III

Preservation of the Layout : Development and presentation of the layout-preparation of machinery layout for fruit, vegetables and meat-size reduction machinery layout-size reducing mills-types of machinery for separation of products by size, shape and colour.

Module IV

Processing plant layout : Evaporation plant layout-single, multiple, vacuum and film evaporators-types and concepts, drying plant layout- drying process, drier types, selection of driers

Bake oven and frying plant-types, concepts and layout. Filing closing and labeling plant layout. Organization and trends in plant layout- sample layout, installation procedure for food processing plant.

References:

1. James, M.More. 1976. *Plant layout and design*. Mac Millian Publishing Co., New york
2. Slade, F.H.1967. *Food processing plant*. Leonard hill Books. London
3. American Society of Heating, Refrigerating and Air- conditioning engineers, 1981, *ASHRAE handbook, fundamentals*, ASHRAE, Atlanta, Georgia
4. American society of heating, refrigerating and Air- conditioning engineers. 1982. *ASHRAE handbook, fundamentals*, ASHRAE, Atlanta, Georgia Hall, H.S and Y. Rosen 1976. *Milk plant layout- (FAO Publication)*

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1606 ELECTIVE I

FT1606 E1 FERMENTATION & ENZYME TECHNOLOGY

Module I

Introduction & overview : Principles of food and industrial fermentation I microorganisms important in food fermentations, Biochemistry of fermentations I fermentation pathways, starter culture.

Module II

Food Fermentation: Exotic fermentations, wine fermentation, Beer and other yeast fermentations. Vegetables, bread making, fermented meats and sausages

Module III

Enzyme Immobilization: Immobilizes enzyme technology to indicate production of enzyme, immobilization techniques - changes in enzyme properties - Scaling up to commercial food application.

Module IV

Enzymes Of Food Importance: Production of Industrial Enzymes Endogenous enzymes in food - Phenolase, Pectic enzymes, Amylases, flavour enzymes, Lipolytic enzymes, Lipoxxygenase, Peroxidase.

Production of industrial enzymes including Renner technology, processing,

References:

1. Doyle M.P., Benahat L.R., and Montville T.J., "Food Microbiology Fundamentals and Frontiers": ~d edition, ASM Press, 2001.
2. Cantarelli c., and Lanzanni G., "Biotechnology applications in Beverage Production", Elsevier Applied Science, 1989.
3. Hui Y.H., Lisbeth Meunier, Goddik Ase Solvejg Hansen, Oytte Josephsen, Wal:Kil Nip, Peggy S. Stanfield and Fidel Toldra: "Handbook of Food and Beverage Fermentation"
4. *Biotechnological Innovation in Food Processing*, (Biotechnology Open Learning BIOTOH series) Brithworth Heineman, 1991.
5. "Encyclopaedia of Food Microbiology" (Academic Press).
6. Martin R. Adams, M.J. Robert Nont, "Fermentation and Food Safety", Aspen Publishers Inc. Maryland
7. Joshi V. K. and Ashok Pandey, "Biotechnology: Food Fermentation Vol. I Microbiology, Biochemistry and Technology": Educational Publishers and Distributors, Ernakulam

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT1606 E2 - FOOD FLAVOURINGS

Module I

Food flavor and its importance to consumers and food processors. Flavor and nutrition. Sources, extraction, delivery systems, and analyses (chemical, instrumental, and sensory) of flavours and flavorings in foods. Sensory perception of flavor: Senses of taste and smell, tasting versus sniffing, astringency, pungency, interaction of senses in flavor perception; taste,

odour, and acceptance of flavor stimuli.

Module II

Chemistry of substances responsible for taste and flavor-taste sensations, flavour enhancers, flavour potentiators or modifiers. Methodology of sensory evaluation and determination of threshold levels as specified by BIS. . Natural, Nature identical and Synthetic flavors: Definitions, chemical composition/constituents

Module III

Flavoring constituents of various foods like meat, fish, milk, vegetables, fruits, fats & oils, spices & herbs, cereals and pulses. Flavor changes during processing, preservation, packaging, and storage of foods. Roles as sulfur compounds, fatty acids, amino acids, terpenoids, lactic acid-ethanol in food flavours. Process and reaction flavours/volatiles in foods.

Module IV

Spices and herbs as food flavorings: Processing of basil, mint, saffron, cloves, tamarind, ginger, cardamom, chilies, pepper etc. for essential oils, extracts and oleoresins as the case may be.. Determination of hygroscopic nature and shelf life/acceptance of foods. Extraction and preparation of flavors, Stability and utility of flavor preparations. Methods used in flavor evaluation

References:

1. Food Chemistry by Fennema
2. Spices & Flavor Technology by Pruthi, J.s.

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT1606 E3- FOOD LAWS AND REGULATION

Module I

Introduction, concept of food safety and standards, food safety strategies. Food hazards and contaminations - biological (bacteria, viruses and parasites), chemical (toxic constituents / hazardous materials) pesticides residues / environmental pollution / chemicals) and physical factors. Preventive food safety systems - monitoring of safety, wholesomeness and nutritional quality of food. Prevention and control of microbiological and chemical hazards. Food safety aspects of novel methods of food processing such as PEF, high pressure processing, thermal and non thermal processing, irradiation of foods.

Module II

Indian and Food Regulatory Regime (Existing and new), PFA Act and Rules, Food Safety and Standards Act, 2006, Essential Commodities Act, 1955, Global Scenario, Codex Alimentarius, WHO/FAO Expert Bodies (JECFA/JEMRA/JMPR) WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR). Food safety inspection services (FSIS) and their utilization.

Module III

Introduction to OIE & IPPC, Other International Food Standards (e.g. European Commission, USFDA etc). WTO: Introduction to WTO Agreements: SPS and TBT Agreement, Export & Import Laws and Regulations, Export (Quality Control and Inspection) Act, 1963. Customs Act and Import Control Regulations, Other Voluntary and mandatory product specific regulations, Other Voluntary National Food Standards: BIS Other product specific standards; AGMARK. Nutritional Labeling, Health claims.

Module IV

Risk assessment studies: Risk management, risk characterization and communication. Voluntary Quality Standards and Certification GMP, GHP, HACCP, GAP, Good Animal Husbandry Practices, Good Aquaculture Practices. ISO 9000, ISO 22000, ISO 14000, ISO 17025, PAS 22000, FSSC 22000, BRC, BRCIOP, IFS, SQF 1000, SQF 2000. Role of NABL, CFLS.

References:

1. Singal RS (1997). Handbook of indices of food quality and authenticity. Woodhead Publ. Cambridge, UK.
2. Shapton DA (1994). Principles and practices of safe processing of foods. Butterworth Publication, London. Winton AL (1999) Techniques of food analysis, Allied Science Publications New Delhi.
3. Pomeranze Y (2004). Food analysis - Theory and Practice CBS Publications, New Delhi.
4. Jacob MB (1999). The chemical analysis of foods and food products. CBS Publ. New Delhi

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT1606 E4- PLANT MAINTENANCE, SAFETY AND HYGIENE

Module I

Plant maintenance program, role of maintenance staff and plant operators

Preventive maintenance, Guidelines for good maintenance and safety precautions, Lubrication and lubricants, Work place improvement through 5S

Sanitation ,needs for sanitation, laws and regulation and sanitizing agent, cleaning and disinfectants, water supply, materials for good sanitation

Module II

Indian factories act on safety, HACCP, GMP, GHP, GAP, Personal protective equipment, accident investigation report, safety promotion activity, environmental pollution and its control

Module III

Principles of food safety, indicators of risk analysis, risk management, clothing and personal hygiene , hygienic and sanitation requirement in different food processing units, pest control in food processing ,storage and service area

Module IV

Food allergy , cross contamination , food intolerance ,contaminants of processed food , metallic contaminants , food poisoning , solvent residue , contaminants of smoked foods ,pesticide residue , food toxins

References:

1. Basic concepts of Industrial Hygiene, Ronald M Scott, CRC Press
2. Safety design criteria for industrial plants. Maurizio Cumo & Antonio Navigilla CRC Press.
3. Industrial Hygiene & Toxicology by Josef Brozek – 1948
4. Food Hygiene, Microbiology & HACCP. S J Forsythe, P R Hayes. Springer

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 16L1 – FOOD PROCESSING LAB

1. Qualitative and quantitative analysis of food additives.
2. Analysis of toxic metals and chemicals in foods.
3. Sensory analysis of foods.
4. Extraction and assay of enzymes.
5. Enzyme kinetics.
6. Vitamin assays using spectro photometric, colorimetric and microbial assay methods.
7. Use of chromatographic techniques.
8. Experiments on preparation of various processed food products from fruits and vegetables, cereals and legumes, milk and its products, Fish meat and poultry, eggs, soft Drinks, Instant Mixes, extruded products, etc. and fermented foods.
9. Evaluation of the quality of various processed food products by analysis

Note : 50% marks is earmarked for continuous evaluation and 50%marks for end semester examination to be assessed by two examiners. The candidate shall secure a minimum of 50% in the aggregate and 50% minimum in the end semester examination for a pass.

FT 16L2 – MINI PROJECT

Each batch comprising of 3 – 5 students shall design develop and realize innovative ideas in food processing sector. Basic elements of product design must be considered. Each students shall submit a project report at the end of semester. Innovative design concepts, reliability consideration taken in project shall be given due weightage.

Guidelines for evaluation:

i) Attendance and Regularity	10
ii) Work knowledge and Involvement	30
iii) End-Semester presentation & Oral examination	20
iv) Level of completion and demonstration of functionality/specifications	25
v) Project Report	15
<i>Total</i>	100 marks

Note: External projects and R&D projects need not be encouraged at this level. Points (i) & (ii) to be evaluated by the project guide & co-ordinator and the rest by the final evaluation team comprising of 3 teachers including the project guide.

SEMESTER VII

FT 1701-FOOD QUALITY SYSTEMS & MANAGEMENT

Module I

Food quality control and labeling: Concepts of quality: Quality attributes-physical, chemical, nutritional, microbial and sensory; their measurement and evaluation; Sensory vis-avis instrumental methods for testing quality. Labelling, Nutritional labelling, Specification, rules and regulation

Module II

Quality and Safety assurance certification: Concepts of quality management: Objectives, importance and functions of quality control; Quality management systems in India; Sampling procedures and plans; Food Safety and Standards Act,2006;Domesticv regulations; Global Food safety Initiative; Various organizations dealing with inspection, traceability and authentication ,certification and quality assurance (PFA,FPO,MMPO,MPO,AGMARK,BIS); Labelling issues; International scenario, International food standards. Food safety BVQI,APEDA,MEPDA and Standard Authority of India ,

Module III

Quality and Safety assurance : Quality assurance, Total Quality management ;GMP/GHP;GLP,GAP;Sanitary and hygienic practices; HACCP; Quality manuals, documentation and audits ;Indian and International quality systems and standards like ISO and Food Codex; Export import policy ,export documentation ;Laboratory quality procedures and assessment of laboratory performance; NABL accreditaion; Applications in different food industries ;Food adulteration and food safety.

Module IV

Testing and Evaluation: Testing and evaluation of quality attributes of raw and processed foods; Detection and estimation of food additives and adulterants; Quality assurance procedure, GMPGAP documentation, Application of HACCP to products ,Preparation of HACCP chart; Preparation of documentation &records; Visit to units with HACCP certification; Food sanitation , Food allergy, Food intolerance ,Health hazards, Food adulteration

References:

1. *Amerine MA,Pangborn RM & Rosslos EB.1965.Principles of Sensory Evaluation of Food; Academic Press*
2. *Early R 1995. Guide to Quality Management Systems for Food Industries; Blackie Academic*
3. *Furia TE 1980 Regulatory status of Direct Food Additives ,CRC Press*

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1702 ENGINEERING PROPERTIES OF FOOD

Module I

Physical Properties of food: Physical properties of food measurement- aero and hydrodynamic properties- definition and scope-measurement of aero and hydro dynamic properties-Surface properties, Gibbs absorption equation and contact angle measurement techniques-Colorimetric properties of food –Physiological basis of colour ; measurement of colour

Module II

Thermal and thermodynamic properties of food: Thermal properties of food- definition and scope- specific heat-enthalpy- thermal conductivity- measurement of thermal properties of food- thermal diffusivity- surface heat transfer coefficient - Thermodynamic properties of food in dehydration- chemical potential and safe equilibria- fugacity and activity- measurement of water activity- moisture sorption isotherm- effect of temperature- sorption energetic-dehydration principle and processes

Module III

Rheological properties of food: Rheological properties of solid foods- quasi static tests for solid foods- relaxation-dynamic testing of solid foods- resonance- empirical and initiative test- rheology of solids, liquids- textural characteristics.

Viscosity of foods - mechanical damage- viscometers.-Measurement of flow properties of fluid foods –Dynamic testing of solid foods and other testing methods

Module IV

Electrical properties of food: Electrical properties of foods- electrical characteristics- dielectric properties-transmission properties- electromagnetic field effects-Electric field strength and ingredients on electrical conductivity of food

Dielectric measurements- dielectric behavior- polar solvents- ionic solvents- no interactive mixtures- moisture content and water activity- temperature variations- frequency variations-Assessment of food quality by dielectric properties

References:

1: Rao M.A and Rizvi S S H, *engineering properties of foods*

2: Mohensenin N N, 1980, *physical properties of plants and animal materials*, Gordon and breach publishers. New York

3: Mohensenin N N, 1980, *thermal properties of foods and agricultural material*, Gordon and breach publishers. New York

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1703 FOOD PACKAGING TECHNOLOGY

Module I

Introduction to packaging: Introduction-evaluation of packaging- economics- packaging operations- packaging terminology. Hazards in distribution- functions of package- design of packages for various foods –Primary packaging materials and properties

Module II

Properties and shelf life packaging materials : Development of protective packaging, shelf life studies using packaging materials methods of shelf life estimation- packaging materials-properties and identification paper and paper boards - Special problems of packaging food stuffs- packaging of various foods compatibility- toxicity- packaging equipments- packaging standards and regulations.

Module III

Types and methods of packaging : Regenerated cellulose film-plastic films- aluminum foils and laminations. Edible packaging- Food packages- bags, pouches, carton boxes. metal and plastic tubes, moulded plastic containers, glass containers. Special packaging methods- vacuum and gas packaging, shrink package, retort pouches- Bio degradable packages –aseptic packaging , CAP & MAP, active packaging ,shrink packaging ,lined cartonning system

Module IV

Canning operations : Canning of food products- types of cans- open top sanitary cans- tin plate grades-lacquering and sealing compounds for OTS cans- canning operations- can washing and sterilization- exhausting- seaming- reforming and flanging operations- retorting of cans–Bottling, capping, labeling , Form-fill sealing ,strapping , cartonning machineries

References:

1. Sachrow & Griffon, "Food packaging"
2. Heiss R., "Principles of food packaging"
3. Paine E.A, "Fundamentals of packaging".
4. Day P.T., "Packaging of food beverages"
5. Brody AL. "Flexible packaging of foods"
6. Matz S.A, " Bakery Technology and Engineering". AVI, Westport, USA

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1704- INSTRUMENTATION AND PROCESS CONTROL

Module I

Introduction to process control: Importance ,aims, Objectives, Introduction to set point disturbance, closed loop and open loop control, feed back and feed forward configurations, types of controllers. Transforms of common function, derivatives, Initial value and final value theorems. Inverse lap lace transforms .methods of partial fractions to invert lap lace domain terms. Applications of Laplace transforms to solve differential equations. Convolution integrals.

Module II

Introduction to system dynamics : Concept of dynamic response, Linear systems, first order systems, definition of terms such as transfer function, time constant, gain of the process with practical examples. response of the process to standard inputs. Second order systems, systems in series, response of these systems to standard inputs, pole and zeros of the functions. Dead time, use of pade approximations. Dynamics of feedback controlled systems, closed loop transfer functions, servo and regulatory problems, modeling the effects of controller action: offset, closed -loop gain, controller gain, effect of controller parameters.

Module III

Stability analysis :Notion of stability, characteristic equations. Routh stability criterion- Root locus method – Frequency response by Bode diagram-Design of controllers using open loop response. Ziegler Nichols approach, experimental determination of process model.

Module IV

Principles of measurement : Principles of transductions, Introductions to error, accuracy, sensitivity, measurement of pressure (pressure gauge, strain gauge, macleod gauge, vacuum measurement. DP cell etc.) temperature (thermocouple, resistance thermometer, thermistor, Pyrometers etc.) Level and flow measuring devices, composition measurements. Types of controllers, basic design of pneumatic controllers and electric - electronic controllers, control valves etc.

References:

1. *Moreira Rosana G.: "Automatic Control for Food Processing Systems", Aspen Publishers, 2001*
2. *Gauri S. Mittal, Computerised Control System in the Food Industry"*

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT-1705 ELECTIVE II

FT 1705 E1 BEVERAGE PROCESSING

Module I

Introduction: Beverage -definition-why we drink beverage-ingredients-water, carbon dioxide, sugar, flavours, colour, sweeteners, emulsifiers and stabilizers

Module II

Beer and wine manufacturing : Ingredients- Malt-hops-cereal adjuncts-water, Beer manufacturing, malting-wort, brewing, fermentation storage, finishing and packaging. Wine- fermentation-types red and white.

Module III

Carbonated and non carbonated beverages: Carbonated and non carbonated beverages Procedures-carbonation equipments and machineries-ingredients- preparation of syrup-packaging- containers and closures
Coffee bean preparation-processing-brewing-decaffeinating-instant coffee- tea types- black, green and oolong- fruit juices based beverages-squash. RTS, isotonic beverages.

Module IV

Quality control : Filling-inspection and quality controls-sanitation and hygiene in beverage industry; Quality of water used in beverages-threshold limits of ingredients

References:

1. *Technology of carbonated beverages, AVI Publication*
2. *Formulation and production of carbonated soft drinks by AJ Mitchal Blackie publishers.*
3. *Hui et al., Hand book of food and beverage fermentation*
4. *Boulton, Brewing yeast and fermentation*

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1705-E2 FOOD PROCESS MODELLING

Module I

Empirical Model Development: Identification of independent and dependent parameters in food processing operations and product development; Factorial, fractional factorial and rotatable central composite experimental design; Coding of the independent parameters and development of empirical equations between independent and dependent parameters; Finding relative importance of independent parameters on individual dependent parameters.

Module II

Artificial Neural Network Modeling: Developing predictive model between independent and dependent parameters by using Artificial neural network – Neural network architecture, weights and bias values of neurons, least square method for NN parameters optimization matrix representation and computation of the values of NN parameters.

Module III

Genetic Algorithm Optimization: Traditional optimization techniques and their limitations, nontraditional method, fitness functions in biological evolution, computational procedure for optimization of independent parameters using Genetic algorithm.

Module IV

Sensory Evaluation using Fuzzy Logic: Identification of sensory characteristics of foods, preparation of sensory score card, analysis sensory data for finding overall sensory quality in triplets, similarity measures in standard fuzzy scale, ranking of food samples and their quality attributes.

References:

1. Ruguo Hu, Ph.D. *Food Product Design A Computer-Aided Statistical Approach*, Technomic Publishers
2. Howard R. Moskowitz, Sam Saguy, Tim Straus (eds), *An Integrated Approach to New Food Product Development*, CRC Press
3. Howard R. Moskowitz, Sebastiano Porretta, Matthias Silcher (eds), *Concept Research in Food Product Design And Development / Blackwell Publishing Ltd*,

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1705 –E3 TECHNOLOGY OF MEAT POULTRY AN EGG PROCESSING

Module I

Pretreatments of meat: Meat- nutritional quality of meat and poultry, structure of muscles-factor affecting quality of fresh meat- grading based on- maturity, degree of fat marbling-muscle firmness, colour, slaughtering-pre slaughter care- stunning, methods of stunning bleeding-skinning of animals ..

Module II

Aging of meat : Post slaughter care-post mortem and biochemical changes in meat- rigour mortis tenderization artificial tenderization- muscle stretching-mechanical disruption artificial enzymes.

Module III

Meat preservation and products : Meat preservation- Methods of preservation-low temperature, chilling and freezing-Thermal processing- dehydration- curing and smoking-preservation using antibiotics-preservation by irradiation. Meat products- Ham and Beckon, sausage, quality control and standardization of meat.

Module IV

Poultry and Egg processing : Dressing- grading- slaughtering-scalding-Mechanical defeathering- eviscerating preservation- Quality control and standardization of poultry meat.

Composition and nutritive value of eggs- grading and preservation of egg defects spoilage of egg-storage-manufacturing of egg powder, frozen egg pulp, waste from egg industry- utilization

References:

1. Mead. 1989, *Processing of Poultry*
2. Richardson and Mead. 1999. *Poultry meat science.*
3. Person and Tauber. 1989. *Muscle and meat biochemistry.*
4. Barbut. 2002. *Poultry products processing an industry guide*
5. Kinsman. 1994. *Muscle foods*
6. Pearson and Dutson. 1994. *Quality attributes and their measurement in meat poultry and fish*

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1705-E4 BAKERY AND CONFECTIONERY TECHNOLOGY

Module I

Introduction To Baking Technology: Status of Bakery and Confectionary industries in India - Raw materials for Bakery products - flour, sugar, shortening agent, yeast, salt. FPA specification of raw materials. Wheat- varieties - qualities for baking - quality grading system for wheat - wheat milling, refined wheat flour, aging- by- products of wheat milling - semolina, wheat gum, grits, suji and bran.

Module II

Technology Of Bakery Products: Technology of baking - dough rheology - preparation of breads, biscuits, crackers, cakes, buns, pizza. Extrusion technology - principles and methods. Pasta foods like macroni, noddles and sphagetti.

Module III

Confectionery Products : Types of confectionery products - ingredients - preparation of toffees, chocolates, fruits bars, candies, chewing gum, bubble gums and special confectionary products - packaging requirements

Module IV

Quality Control And Sanitation: Quality control of baking items - standards and regulations - hygienic conditions required in bakery and confectionery units.

References:

1. *Martz, "Bakery Technology and Engineering" Elsevier, Tokyo.*
2. *Manfie, "Chocolate, Cocoa and Confectionery Science & Technology (3rd edition) Advance Books, Jaipur.*
3. *Kent, "Technology of cereals".*
4. *Kent, "Cereal Technology".*
5. *Scott, "Flour milling process"*
6. *Spicer, "Bread".*

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 17L1 -FOOD PRESERVATION LAB

- 1.Experiments based on preservation methods such as thermal processing, freezing, dehydration, etc.
- 2.Thermal process time determination and evaluation of a process.
3. Drying rate studies including constant rate and falling rate periods and the effects of various factors on them.
- 4.Freezing rate and time studies.
- 5.Effect of temperature of cooling medium and food material on rates.
6. Typical examples of preparation of products using these preservation techniques.
7. Experiments using spray dryer ,freeze dryer ,extruder, tray dryer, fermenter

***Note :** 50% marks is earmarked for continuous evaluation and 50%marks for end semester examination to be assessed by two examiners. The candidate shall secure a minimum of 50% in the aggregate and 50% minimum in the end semester examination for a pass.*

FT 17L2- ENGINEERING PROPERTIES

LIST OF EXPERIMENTS

1. Determination of firmness of fruits and vegetables.
2. Determination of physical properties of foods.
3. Determination of thermal conductivity of foods
4. Estimation of surface area of fruits and vegetables.
5. Determination of specific heat of liquid food.
6. Determination of specific heat of solid food.
7. Determination of viscosity of food by rotational viscometer.
8. Determination of porosity of food using air pycnometer.
9. Experiments on sensory properties of food.
10. Determination of refractive index of food.
11. Determination of compression and tensile strength of packaging material.
12. Experiments on ohmic heating.

Note : 50% marks is earmarked for continuous evaluation and 50%marks for end semester examination to be assessed by two examiners. The candidate shall secure a minimum of 50% in the aggregate and 50% minimum in the end semester examination for a pass.

FT 17L3 PROJECT DESIGN

Each batch comprising of 3students shall identify a project related to curriculum of study .At the end of semester each student shall submit a

a project synopsis comprising of the following:

- Application and feasibility of the project
- Complete and detailed design specifications
- Block level design documentation
- Bill of materials used if any' subject to the maximum permitted
- Project implementation action plan and economic feasibility :

Guidelines for evaluation:

i) Attendance and regularity	10
ii)Quality and adequacy of design documentation	10
iii) Concepts and completeness of design	10
iv) Theoretical Knowledge and individual involvement	10
v) Quality and content of project synopsis	10

Note: Points(i)-(iii) to be evaluated by respective project guide and coordinator based on continuous evaluation .

Points iv –v to be evaluated by final evaluation team comprising of three internal examiners including the project guide

FT 17L4 SEMINAR

Students shall individually prepare and submit a report on a topic of current relevance related to the field of Food Technology. The reference shall include standard journals' conference proceedings, reputed magazines and textbooks and technical reports which will reflect the state of the art in the selected topic. Each student shall present a seminar for about 30 minutes for about 30 minutes duration on the selected topic. The report and presentation will be evaluated by a team of internal experts comprising of 3 teachers based on style of presentation, technical content, adequacy of references, depth of knowledge and overall quality of the seminar report.

SEMESTER VIII

FT 1801- MANAGEMENT OF FOOD PROCESSING INDUSTRIES

Module I

Production and Inventory Management: Introduction to food industry management - nature of processing industry production planning- batch and continuous production, Process planning- definition and concepts, Inventory control- classification, economic ordering, inventory models, ABC analysis.

Module II

Financial management: Assessing, acquiring and allocating funds- cash flow statement- balance sheet financial ratio- break even analysis- concept, application in food industry- project appraisal

Module III

Market management: Concepts- consumer market, business market, marketing environment- market segmentation- market measurement and forecasting- advertisement- publicity market information system- market research- management of distribution channel. Consumer buying behaviour- factors influencing consumer buying behaviour. Export, trade- Government regulations, GAIT, WTO regulation, Trade Act regulation relating to maintain hygienic conditions. GAIT and world trade organization regulations, Patent.

Module IV

Intellectual property right and patent: Kind of patents –Indian patent law ,meanings scope objectives –Kind of patent applications –Procedure for obtaining patent- Patent specifications-Drafting ,claims ,patent oppositions ,enforcement and revocation-Fee structure –Sources of patent information ,patent databases, IP –licensing and technology transfer

References:

1. Philip Kotler, 1985, *Marketing management, Prentice Hall of India*
2. Brigham, Eugene, F. 1989. *Fundamentals of financial management, The Dryden press*
3. Sherilaker. 1985. *Marketing management, Himalaya Publishing Company.*
4. Mehtha., P.L. *Managerial Economics- Analysis, problems and cases, Sultan Chand and Sons, New Delhi*

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1802-ENTREPRENEURSHIP DEVELOPMENT FOR FOOD TECHNOLOGY

Module I

Indian Economy and contribution of various sub-sectors in the economy. Structural base of Indian economic Life. Contribution of MSME sectors in the national economy. Impact of globalizanon and liberalization on MSME sectors. Agricultural sector and food processing industry problems and opportunity. Self employment need and various mode open in Food Processing and Agri- sector

Module II

Fundamentals of marketing principles and marketing mix, Sales and distribution management, Costing and cost management, pricing methods, fundamentals of operations and supply chain management, organization structure and human resource management , capital structure and methods of raising fund . Opportunity identification and feasibility studies, financial analysis, technical entrepreneurship .Project sizing , fund management and enterprise management issues.

Module III

Problem solving, decision making processes and tools, conflict and change management in a new industrial enterprise, Systems approach and consideration in an entrepreneurial venture. Management reporting and information system for monitoring and control of the new enterprise, managing Innovation. Marketing challenges and approaches for new products and services sustaining in a competitive environment

Module IV

Preparation of feasibility report on an identified opporfunity approved by the course coordinator based on standard structure.

References:

1. Philip Kotler, 1985, *Marketing management, Prentice Hall of India*
2. Brigham, Eugene, F. 1989. *Fundamentals of financial management, The Dryden press*
3. Sherilaker. 1985. *Marketing management, Himalaya Publishing Company.*
4. Mehtha., P.L. *Managerial Economics- Analysis, problems and cases, Sultan Chand and Sons, New Delhi*

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1803-TECHNOLOGY OF PLANTATION CROPS AND SPICES

Module I

Processing of tea: Processing of tea - various types of tea, chemistry of constituents, harvesting, fermentation tea concentrates decaffeination process Evaluation and grading of tea

Module II

Processing of coffee: Processing of coffee - type of coffee, drying, fermentation, roasting and browning processes and their importance, chicory chemistry and technology
Analysis of tea and coffee quality components, standards and specification of tea and coffee products. Processing and analysis of cocoa bean, beverages and study of factors that affect quality and uses for the consumers.

Module III

Spices and culinary herbs: Introduction: Importance and role of spices in food processing, Classification and properties of spices,
Scope of spice processing in India,
Spices and culinary herbs: Types, spice qualities and specifications/ uses and physiological effects, components, antimicrobial and antioxidant properties of spices and herbs, important spices and medicinal herbs added in food products and their processing.

Module IV

Spice processing: Spice processing; Processing and manufacturing of major Indian spices and herbs, Pepper, cinnamon, cardamom, Nutmeg, saffron, Turmeric and Ginger, Minor spices- cloves, leafy spices, bay oregano, seed spices, common herbs- brahmi, tulsi, mint, thyme, curry leaves, lemon grass etc., Medicinal values of herbs, condiments and spice products, spice blends and extractives, essential and encapsulated oils, salad dressings and seasonings, oleoresins, uses in processed foods and spice processing machineries

References:

- 1) Kenneth T Farrel (1985) *Spices, condiments and seasonings*. The AVI Pub. Company
- 2) J.W. Purseglove, E.G Brown, C.L Green and S.R.J Robbins (1981) *Vol I and II Spices* Longman Publications
- 3) Kenji Hirasa and Mitsuo Takemasa (1998) *Spice Science and Technology*, Marcel Dekker, Inc

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B

FT 1804-ELECTIVE III

FT 804 E1 -FISH PROCESSING TECHNOLOGY

Module I

Importance and nutritive values of fish : Fishing resources - Inland, marine, Brackish water fisheries, harvesting methods crafts - gears.

Composition and nutritive value of fish - protein, Omega 3 fatty acid, toxic components - biochemical and microbiological changes in fish - Evaluation of fish qualities - transportation of fish - washing - Grading

Module II

Fishery products : Fish meal and oil - Chitin and Chitosan - fermented fish products - fish paste products - fish protein concentrate - utilization of fish processing waste

Module III

Preservation of fish : Processing of fish and shellfish - freezing - individual quick freezing - canning salting - drying and dehydration - smoking of fish. Irradiation - fish mince and surumi.

Module IV

Quality control of fish : Spoilage of fish - quality control of fresh fish. HACCP of dish - quality assurance of seafood

References:

1. Andrew. L. Winton, Kate Barber winton, 1993. *Fish and Fishproducts Afro Botanical Publishers, India*
2. K. Gopakumar. 1993. *fish Packaging technology (Materials and methods) concept pUblishing company, New delhi*
3. Cop. Mallett 1993. *frozen food technology, Chapman & Hall, London*
4. Winton/Winton *Fish and fish products. Allied Scientific Publishers, India*

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B

FT 1804 E2 FOOD BIOTECHNOLOGY

Module I

Introduction to biotechnology: Introduction- Biotechnology relating to the food industry-application of genetics to food production- role of bio- process engineering in biotechnology industry. Regulatory and social aspects of biotechnology of foods

Module II

Production of commercially important enzymes and recombinant protein : Protease, amylase, lipase, cellulose, pectinase, isomerase and other commercially important enzyme for the food industry.
The process of production of some commercially important organic acids- citric acid- lactic acid, acidic acid, gluconic acid, amino acids and alcohol- Bio products industries- natural bio- preservatives- Nisin.

Module III

Downstream processing: Principle of down stream processing- small, medium and large scale processing. Bacterial starter culture, methods of inoculation, medium preparation- slurry processing and product isolation

Module IV

Application of enzymes in food industry : Production of food flavour -color - enzymes- immobilized enzymes. Application in enzyme in meat industry, fruit and vegetables industry, dairy industry.'

References:

1. Board R.B. Jones.D, 1995, *Microbial Fermentation Beverages, foods and Feeds*
2. Sarah Elderidge. 2003. *Food Biotechnology; Current issues and perspective. Nova science Pub. Inc.*
3. Gustavo F. Gutierrez. 2003. *Food science and food biotechnology. GRC Pub.*
4. Brian J. Ford 2000 . *Future of food. WW Norton and Co. In*

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1804 E3 FOOD INDUSTRY WASTE MANAGEMENT

Module I

Waste Utilization From Cereal Food Industries : Different sources of wastes from food industries and their availability in India nature of different waste - Waste utilization from rice mill - Thermal and biotechnological use of rice husk - cement preparation and different thermal applications - utilization of rice bran - stabilization - defatted bran utilization.

Module II

Utilization Of Fruit And Vegetable Wastes : Processes for Waste utilization from fruit and vegetable industries - Distillation for production of alcohol - oil extraction from waste - waste management in sugar mills - citric acid production from fruit waste.

Module III

Fish, Meat And Poultry And Tuber Crops Waste Utilization : Fish industry by products and waste utilization - meat and poultry waste recycling. Waste from tuber crops - effluent safe disposal - effluent treatment plant – waste - recycling plant - feasibility report for food industries using food waste and by products.

Module IV

By-Products Utilization Of Wheat And Pulse Mill : By products of wheat milling - germs and bran - by products of pulses milling husk, germs and broken. Coconut processing - by-product utilization - fuel briquette.

References:

1. P.N Chereminnoff & AC Morresi, 1976, "Energy from Solid Wastes"
2. AChakravarthy & De, "Agricultural Waste and By Product Utilisation".
3. Bor S. Luli ed), "Rice Production and Utilisation"
4. E. Beagle, "Rice Husk Conversion to Energy"

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 1804 E4 NUTRACEUTICALS AND FUNCTIONAL FOODS

Module I

Basics of nutraceutical & functional foods: Basics of nutraceutical & functional foods Defining nutraceuticals and functional foods. Nature, type and scope of nutraceutical and functional foods. Nutraceutical and functional food applications and their health benefits. Nutraceutical compounds and their classification based on chemical and biochemical nature with suitable and relevant descriptions. Nutraceuticals for specific situations such as cancer, heart disease, stress, osteoarthritis, hypertension etc:-

Module II

Proteins, Carbohydrates & Fats as functional foods & nutraceuticals: Proteins as functional food ingredients i.e. whey proteins, soya proteins etc. Complex carbohydrates and Fibres as functional food ingredients Antioxidants and other phyto chemicals, (isoflavones,lycopenes), phytosterols and their role as nutraceuticals and functional foods. Oils with MUFA, n3 & n6 PUFA as nutraceuticals &functional foods

Module III

Foods as nutraceutical & functional foods: Probiotic foods and their functional role. Cereal products as functional foods - oats, wheat bran, rice bran etc. Functional vegetable products i.e. vegetables and fruits, oil seeds etc. Sea foods. Fat replacers Beverages such as green tea, coffee, cocoa, fruit juices as functional foods and their protective effects. Herbs as functional foods, health promoting activity of common herbs.

Module IV

Stability & safety issues: Stability & bio availability of functional ingredients in foods Effects of processing, storage and interactions of various environmental factors on the potentials of such foods, interaction if drugs & nutraceuticals.

Safety, regulatory issues and marketing for functional foods and nutraceuticals-

Future of nutraceuticals & functional foods, Recent developments and advances in the areas of nutraceutical and functional foods and their role in nutrigenomics in health care

References:

1. *Human Nutrition by Benjamin T Burton, Mc Graw Hill*
2. *Nutrition and Dietetics by Shubhangini A Joshi ,Tata Mc Graw Hill Co. Ltd*
3. *Dietetics by B.Shrilakshmi ,New Age International (P) Ltd New Delhi*
4. *Type of Questions for University Examination*
5. *Q1: Eight short answer question of 5 marks with two questions from each of four modules*
6. *Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.*

Type of Questions for University Examination

Q1: Eight short answer question of 5 marks with two questions from each of four modules

Q2 to Q5: Two question A and B of 15 marks from each module with option to answer either A or B.

FT 18L1 MAJOR PROJECT

Each student is required to submit 3 bound type written copies of a project report on a proposed research oriented work :- either theoretical or practical (e.g design of sophisticated food process plant; modeling & simulation of sophisticated food process; optimization of a sophisticated food process; food process experimentation & data Analysis).

The object is to test the ability of the student to apply his entire knowledge of the principles of food engineering in designing food processing plants. It is intended to check the level of the student's originality and capacity for application of laboratory data to a practical situation.

A committee consisting of the Project Coordinator (appointed by the Head of the Department / Division), project guide and at least one senior faculty member will carry out the assessment based on at least one interim review and a final review just before the submission of the project report.

The final evaluation of the project shall include the following.

- Presentation of the work
- Oral examination
- Demonstration of the project against design specifications
- Quality and content of the project report

Guidelines for evaluation:

i.	Regularity and progress of work	60
ii.	Work knowledge and Involvement	60
iii.	End semester presentation and oral examination	60
iv.	Level of completion and demonstration of functionality/specifications	60
v.	Project Report – Presentation style and content	60
<i>Total</i>		300 marks

Note: Points (i) and (ii) to be evaluated by the respective project guide and the project coordinator based on continuous evaluation. (iii)-(v) to be evaluated by the final evaluation team.

FT 18L2 VIVA VOCE

Each student is required to appear for a viva-voce examination at the end of the complete course work. The students shall produce the seminar report and project reports duly attested by the institutional authorities, before the examiners. The examination panel shall comprise of Head of the Department / Division or his/her nominee and one senior faculty of the Department/Division and an external expert .The examiners except the Head of the Department / Division or his/her nominee shall be, both appointed by the University. The examiners shall evaluate the students in terms of their conceptual grasp of the course of study and practical/analysis skills in the field.