B.Tech Civil Engineering Syllabus Structure and Details

Course No.	Course Name	L	T	P	C	Course No.	Course Name	L	T	P	C
Semester I						**Semester II**					
UPH101	Engineering Physics	3	1	0	8	UCH201	Engineering Chemistry	3	1	0	8
UMA101	Engineering Mathematics-I	3	1	0	8	UMA201	Engineering Mathematics-II	3	1	0	8
UEE101	Basic Electrical Engineering	3	1	0	8	UCSE201	Programming for Problem Solving	4	1	0	10
UHSS101	English Communication	2	0	0	4	UCE201	Engineering Drawing and Computer Graphics	1	0	0	2
UME101	Engineering Workshop	1	0	0	2	UHSS201	Professional Ethics and Human Value	2	0	0	4
UPH171	Engineering Physics Lab	0	0	3	3	UCH271	Engineering Chemistry Lab	0	0	2	2
UEE171	Basic Electrical Engineering Lab	0	0	2	2	UCSE271	Programming for Problem Solving Lab	0	0	3	3
UHSS171	English Communication Practice	0	0	2	2	UCE271	Engineering Drawing and Computer Graphics Lab	0	0	4	4
UME171	Workshop Practice	0	0	4	4						
Contact Hours: 26		12	3	11	41	**Contact Hours: 26**		13	3	9	41
Semester III						**Semester IV**					
UMA301	Mathematics-III	3	0	0	6	UMA401	Numerical Methods and Computer Programming	3	0	0	6
UME302	Engineering Mechanics	3	0	0	6	UHSS401	Engineering Economics	3	0	0	6
UCE301	Surveying-I	3	0	0	6	UCE401	Surveying-II	3	0	0	6
UCE302	Fluid Mechanics	2	1	0	6	UCE402	Strength of Materials	3	0	0	6
UCE303	Engineering Geology	3	0	0	6	UCE403	Hydraulic Engineering	2	1	0	6
UCE304	Building Materials & Construction	3	0	0	6	UCE404	Concrete Technology	3	0	0	6
UCE371	Surveying-I Lab	0	0	2	2	UMA471	Numerical Methods and Computer Programming Lab	0	0	2	2
UCE372	Material Testing Lab	0	0	2	2	UCE471	Surveying-II Lab	0	0	2	2
UCE373	Fluid Mechanics & Hydraulics Lab	0	0	2	2	UCE472	Hydraulic Engineering Lab	0	0	2	2
UCE374	Engineering Geology Lab	0	0	2	2	UCE473	Concrete Technology Lab	0	0	2	2
UHSS371	Language Lab	0	0	2	2	UCE474	Civil Engineering Drawing	0	0	2	2
Contact Hours: 28		17	1	10	46	**Total Contact Hours 28**		17	1	10	46
Semester V						**Semester VI**					
UHSS501	Industrial Management and Entrepreneurship	3	0	0	6	UHSS601	Professional Communication	2	0	0	4

UCE501	Design of Structures-I	3	0	0	6	UCE601	Structural Analysis-II	2	1	0	6
UCE502	Transportation Engineering-I	2	1	0	6	UCE602	Transportation Engineering-II	2	1	0	6
UCE503	Structural Analysis-I	2	1	0	6	UCE603	Environmental Engineering-II	3	0	0	6
UCE504	Environmental Engineering-I	3	0	0	6	UCE604	Foundation Engineering	3	0	0	6
UCE505	Geotechnical Engineering	3	0	0	6	UCE605	Hydrology and Water Resources Engineering	2	1	0	6
UCE571	Transportation Engineering-I Lab	0	0	2	2	UCE671	Environmental Engineering-II Lab	0	0	2	2
UCE572	Environmental Engineering-I Lab	0	0	2	2	UCE672	Computer Aided Design	0	0	2	2
UCE573	Geotechnical Engineering Lab	0	0	2	2						
UCE591	Surveying Camp	0	0	2	2						
Total Contact Hours 26		**16**	**2**	**8**	**44**	**Total Contact Hours 21**		**14**	**3**	**4**	**38**
Semester VII						**Semester VIII**					
UCE701	Estimation & Costing	3	0	0	6	UCE801	Construction Engineering and Project Management	2	1	0	6
UCE702	Design of Structures-II	3	0	0	6	UCE802	Design of Structures-III	3	0	0	6
UCE711-UCE715	Elective-I	2	0	0	4	UCE811-UCE815	Elective-III	2	0	0	4
UCE716-UCE720	Elective-II	2	0	0	4	UCE816-UCE819	Elective-IV	2	0	0	4
UCE791	Major Project-I	0	0	8	8	UCE891	Major Project-II	0	0	8	8
UCE792	Industrial Training	0	0	2	2	UCE892	Grand Viva-Voce	0	0	2	2
Contact Hours: 20		**10**	**0**	**10**	**30**	Total Contact Hours: 20		9	1	**10**	**30**

Total Mandatory Credits: 316

B.Tech Civil Engineering Syllabus Details

Semester VI

Paper Code: UCE601   **Credit: 06**
Paper Name: Structural Analysis-II   **L-T-P: 2-1-0**
Total Contact hours: 36

Module I:Introduction   **Contact hours: 04**
Indeterminate structures, Static and Kinetic indeterminacy and their calculation.

Module II:Indeterminate Beams: **Contact hours: 06**
Propped cantilever, Fixed Beam, Continuous beams, sinking of support, temperature effect, and three moment equation.

Module III:Classical Displacement Method   **Contact hours: 13**
Slope deflection method, Moment distribution method, Kani's Method – application to analysis of indeterminate Beams and Building frames.

Module IV:Classical Force Method   **Contact hours: 13**
Trusses and rigid frames by consistent deformation method Column analogy method and elastic centre method. Masonry Dams and Retaining Walls, Condition for No tension. Chimneys, piers and Abutments. Introduction to Fatigue, creep and stress Concentration.

Text/Reference Books:

1. *Basic Structural Mechanics by C.S. Reddy, Tata Mc. Grew Hill.*
2. *Indeterminate Structural Analysis by C.K. Wang, Tata Mc. Grew Hill.*
3. *Theory of Structures by G.S. Pundit, S.P. Gupta & R. Gupta, Tata Mc. Grew Hil.l*
4. *Analysis of Structures Vol. – I &II, by V.N. Vazirani & M.M. Ratwani, Khanna Pub.*

Paper Code: UCE 602   **Credit: 06**
Paper Name: Transportation Engineering-II   **L-T-P: 2-1-0**
Contact Hours: 36

Module 1: Railway Planning   **Contact Hours: 10**
Comparison of Road, Rail, Air and Water transports – Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, – Track Stress, coning of wheels, creep in rails, defects in rails – Route alignment surveys – Geometric design of railways, gradient, super elevation, widening of gauge on curves- Points and Crossings.

Module 2: Railway Construction and Maintenance   **Contact Hours: 06**
Earthwork – Stabilization of track on poor soil, Calculation of Materials required for track laying – Construction and maintenance of tracks – Modern methods of construction & maintenance – Railway stations and yards and passenger amenities.

Module 3: Dock,Harbour and Tunnel Engineering   **Contact Hours: 06**
Definition of Basic Terms: Planning and Design of Harbours: Requirements, Classification, Location and Design Principles – Harbour Layout and Terminal Facilities.

Harbor docks, Wet docks, Repair docks, Lift docks, Floating docks, Slipways.
Tunneling: Introduction, size and shape of the tunnel, tunneling methods in soils, tunnel lining, tunnel drainage and ventilation.

Module4: Airport Planning   **Contact Hours: 06**
Airport classification, airport planning: objectives, components, layout characteristics, and socioeconomic characteristics of the catchment area, criteria for airport site selection and ICAO stipulations, typical airport layouts, Parking and circulation area..

Module 5:Airport Design   **Contact Hours: 08**
Runway Design: Orientation, Wind Rose Diagram, Runway length, Problems on basic and Actual Length, Geometric design of runways, Configuration and Pavement Design Principles, Elements of Taxiway Design, Airport Zones, Passenger Facilities and Services, Runway and Taxiway Markings and lighting.

Text/Reference Books:
1. A Course in Railway Engineering, Saxena Subhash C and Satyapal Arora, Dhanpat Rai and Sons, Delhi.
2. Railway Engineering, Satish Chandra and M.M. Agarwal, second Edition, Oxford University Press, New Delhi.
3.Airport Planning and Design,S. K. Khanna, M. G. Arora and S. S. Jain, Nemchand and Brothers, Roorkee,
4. Transportation Engineering, Volume II: Railways, Airports, Docks and Harbours, Bridges and Tunnels, C Venkatramaiah, Universities Press.
5.A Course in Docks and Harbour Engineering, S. P. Bindra, Dhanpat Rai and Sons, New Delhi.

Paper Code: UCE603   **Credit:06**
Paper Name: EnvironmentalEngineering-II   **L-T-P:3-0-0**
Total Contact Hour: 36

Module 1: Sanitary Engineering   **Contact Hours: 02**
Importantterms, sewagetreatmentsystemandwastewatermanagement.

Module 2: CollectionandConveyanceofSewage   **Contact Hours: 04**
Conservancyandwatercarriagesystem,comparison,classificationofwatercarriagesystem.

Module 3:Waste Water Flow   **Contact Hours: 05**
Estimation of Dry Weather Flow and Storm Water, Variation of flow, Estimation of design discharge.

Module 4:Sewer Design, appurtenance, Construction and Maintenance   **Contact Hours: 06**
Sewer-types, materials, shapes, hydraulic design, minimum & maximum flow. Planning of sewerage system, testing and maintenance.

Module 5:Waste Water Characteristics   **Contact Hours: 05**
Constituent of sewage – physical & chemical, oxygen demand, BOD, COD, Relative Stability, population equivalent, Biological characteristics.

Module 6:Waste Water Disposal   **Contact Hours: 04**
Dilution, self-purification, land disposal, sewage sickness, comparison of disposal methods.

Module 7:Waste Water Treatment   **Contact Hours: 08**

Flow diagram of conventional sewage, treatment plant, Primary treatment – screens, Grit Chambers, detritus tank, skimming tank, sedimentation – Plain & Chemical. Secondary treatment – Trickling fitters, Biological contractor, Activated sludge process, oxidation pond and ditches, aerated lagoon.
Septic tank – design consideration, soak pit and soak trench.

Module 8:Treatment and Disposal of Sludge   **Contact Hours: 02**
Aerobic and anaerobic digestion, disposal of sludge.

Text/Reference Books:

1. EnvironmentalEngineering(Vol-2) byB.C.Purmia,LaxmiPublication.
2. EnvironmentalEngineering(Vol-2) byS.K.Garg,KhannaPublication.
3. EnvironmentalEngineering byMcGhee,McGrawHill.

Paper Code: UCE604   **Credit: 06**
Paper Name: Foundation Engineering   **L-T-P: 3-0-0**
Total contact hours: 36

Module 1: Introduction to foundation engineering   **Contact hours: 02**
Introduction, Purpose of foundation, Classification of foundation, Selection of type of foundation.

Module 2: Stress Distribution   **Contact hours: 05**
Introduction: Stresses due to self-weight, Boussinesq equation, Pressure distribution diagram, Contact Pressure

Module 3: Bering Capacity of soil and shallow foundation   **Contact hours: 10**
Introduction, Modes of failures, Terzaghi's bearing capacity theory, bearing capacity equations, Meyarhoff's equation, Effect of water able, Effect of eccentricity, Plate load test, Settlement of footings.

Module 4: Deep foundation   **Contact hours: 10**
Introduction, Classification of piles, Design of pile foundations, Group action of pile, Pile load test, Negative skin friction, Cassions, Classification of cassions, Well foundation.

Module 5: Soil Exploration Contact hours: 05
Introduction, Different phases of soil exploration, Method of sub surface explorations, Boring methods, Penetration tests, Classification of samples, Bore log.

Module 6: Ground Improvement techniques   **Contact hours: 04**
Introduction, Principle of ground improvement, Soil stabilisation, Grouting, Vertical Drains, Stone column.

Text/Reference Books:

1. Soil Mechanics and foundations, B.C. Punmia, A.K. Jain and A.K. Jain, Laxmi Publications.
2. Basic and applied soil mechanics, Gopal Ranjan, A S R Rao, New Age Publications.
3. Foundation Engineering, Bikash Chandra Chattopadhyay, Jayanta Maity, PHI Publications.
4. Foundation Analysis and Design by Joseph E. Bowles, Tata McGraw Hill.

Paper Code: UCE605   **Credit: 06**
Paper Name: Hydrology and Water Resource Engineering   **L-T-P: 2-1-0**
Total Contact hours: 36

Module 1: Introduction   **Contact Hours:08**
Precipitation Forms, Classification, Variability, Measurement, Data analysis, Evaporation and its measurement, Evapotranspiration and its measurement, Penman Monteith method. Infiltration: Factors affection infiltration, Horton's equation and Green Ampt method.

Module 2: Hyetograph and Hydrograph Analysis   **Contact Hours:05**
Hyetograph, Runoff: drainage basin characteristics, Hydrograph concepts assumptions and limitations of unit hydrograph, Derivation of unit hydrograph S hydrograph, Flow duration curve.

Module 3: Groundwater & Well Hydraulics   **Contact Hours: 07**
Occurrence and movement of groundwater, Darcy's law, governing ground water flow equations, Factors governing ground water flow, Types of aquifers, porosity, specific yield, specific retention, storage coefficient, permeability, hydraulic conductivity, hydraulic transmissibility, Conjunctive use and it's necessity.

Module 4: Flood Management   **Contact Hours: 07**
Indian rivers and floods, Causes of flooding, Alleviation, Leeves and floodwalls, Floodways, Channel improvement, Flood damage analysis.Hydrologic Analysis and Design:Design flood, Flood estimation, Frequency analysis, Flood routing through reservoirs and open channels, Storm drainage design.Drought Management.

Module 5: Water Harvesting   **Contact Hours: 03**
Definition of drought and causes, drought contingency planning. Water harvesting: rainwater collection, small dams, runoff enhancement, runoff collection, ponds, tanks, natural and artificial ground water recharge methods.

Module 6: Reservoir   **Contact Hours:06**
Types, Investigations, Site selection, Zones of storage, Safe yield, Reservoir capacity, Sediment transport:Origin and formation of sediments, stream erosion and deposition, definition of regime of flow, plane bed, ripple and dune regime, transition regime, anti-dune regime, introduction to bed loads, saltation, suspended load and wash load. Classification rivers on alluvial plains – degrading, aggrading and meandering.

Text/Reference Books:

1. Garg S.K., Hydrology and Water Resources Engineering
2. Subramanya, K., Engineering Hydrology, Tata McGraw Hill, New Delhi.
3. Raghunath, H.M., Groundwater, 1987, Wiley Eastern Ltd., New Delhi.
4. Modi, P.N., Irrigation Water Resources and Water Power Engineering, Standard Book House, New Delhi.
5. Todd, D.K., Groundwater Hydrology, 1993 John Wiley & Sons..
6. Raghunath, H.M., Hydrology – Principles, Analysis and Design, 1986, Wiley

Paper Code: UCE671   **Credit:02**
Paper Name: EnvironmentalEngineering-II Lab   **L-T-P:0-0-2**
Total Contact Hour: 24

Module 1: BODdetermination,
Module 2: CODdetermination,
Module3: Membranefiltertechnique,
Module4: Suspended solid, dissolved solid, Total solid tests.
Module5: Airqualitymonitoring.
Module 6: Turbidity Test
Module 7: Residual Chlorine test
Module 8: Fluoride Concentration Test

Text/Reference Books:

1. Training manuals and User manuals

Paper Code: UCE672   **Credit: 2**
Paper Name: Computer Aided Design   **L-T-P: 0-0-2**
Total Contact hours: 24

Module 1:   **Contact hours: 06**
Data download from total station, generation of contours, block levelling, longitudinal and cross-sectional diagrams

Module 2:   **Contact hours: 09**
Analysis of frames, analysis and design of simply supported beam, cantilever beam, fixed beam, column, foundation and slab using commercially available general-purpose software.

Module 3:   **Contact hours: 09**
Reinforcement detailing of foundation, column, beam, slab, lintel, chajja and staircase as per the relevant codes. Seepage analysis, stability of slopes, Sigma and Quake analysis in Finite element software.

Text/Reference Books:
1. *Training manuals and User manuals*

B.Tech Civil Engineering Syllabus Details

Semester VII

Paper Code: UCE701   **Credit: 06**
Paper Name: Estimation and Costing   **L-T-P: 3-0-0**
Total contact hours: 36

Module 1: Introduction   **Contact Hours: 02**
Procedure of estimating: Introduction, Measurements/works/payments. Types of estimates.

Module 2: Building Estimate   **Contact Hours: 08**
Methods of building estimates: Long wall-short wall method, Centre line method. Estimate of single roomed/multi roomed buildings, estimate of masonry platform, and estimate of water tank.

Module 3: Estimate of earthwork   **Contact Hours: 06**
Estimate of earthwork: Methods of estimates for earthwork. Estimate of roadwork/irrigation work

Module 4: Estimate of RCC and Steel work   **Contact Hours: 08**
RCC works, Percentage of steel reinforcement, Standard hooks and cranks, Estimate of RCC framed buildings (Slabs, beams, columns, and footings). Steel stanchion, estimate of a steel stanchion and beams.

Module 5: Rate Analysis   **Contact Hours: 06**
Analysis of rate: Overhead cost, Labour required for different works. Rate analysis of different items of works

Module 6: Valuation   **Contact Hours: 06**
Valuation: Incomes, Outgoings, Scrap value, Salvage value, Obsolescence, Year's purchase, sinking fund, Depreciation, Methods of valuation

Text/Reference Books:

1. *Estimation and costing in civil engineering, B.N. Dutta, UBS Publishers'.*
2. *Estimation, Costing, Specification and valuation, M. Chakraborty, Calcutta.*
3. *A textbook of estimation and costing (Civil), D.D.Kohli & R.C. Kohli, S. Chand*

Paper Code: UCE702   **Credit: 06**
Paper Name: DesignofStructures-II   **L-T-P: 3-0-0**
Total Contact Hours: 36

Module 1: Introduction   **Contact Hours: 04**
Types of Structural Steel, Mechanical Properties of Steel,Cold Work and Strain Hardening, Advantages of Steel asa Structural Materials, Types of Steel Structures, CodesandSpecifications: IS 800:2007. Factor of Safety, Permissible and Working Stresses, Elastic Method, Plastic Method, Introduction to Limit States method ofDesign.

Module 2: Connections   **Contact Hours: 06**
Type of Connections, Riveted, Bolted and Welded Connections, Strength, Efficiency and Design of Joints, Modes ofFailure of a Riveted Joint, Advantages and Disadvantages of Welded Joints, Design of Fillet and Butt Welds, DesignofEccentricConnections.

Module 3: TensionMembers   Contact Hours: 06
Net Sectional Area, Permissible Stress, Design of Axially Loaded Tension Member, Design of Member Subjected toAxialTensionandBending.

Module 4: CompressionMembers   Contact Hours: 06
ModesofFailureofaColumn,BucklingFailure: Euler's Theory, Effective Length,SlendernessRatio, DesignFormula: I.S. Code Formula, Design of Compression Members, Design of Built-Up Compression Members: LacedandBattenedColumns.

Module 5: Beams   Contact Hours: 06
DesignProcedure,Built-UpSections,PlateThickness,WebCrippling, and WebBuckling,Connections andCurtailmentofFlangePlates.

Module 6: Beam-Column   Contact Hours: 04
EccentricityofLoad,InteractionFormulae,DesignProcedure,EccentricallyLoadedBasePlates.

Module 7: Plate Girders   Contact Hours: 04
Web panel subjected to shear, webs subjected to combined bending and shear, design of plate girders using IS 800:2007.

Text/Reference Books:

1. N. Subramanian, Design of Steel Structures, Oxford University Press, 2008.
2. S. K. Duggal, Limit State Design of Steel Structures, McGraw-Hill, 2014.
3. S. S. Bhavikatti, Design of Steel Structures by Limit State Method, I.K. International Publishing House, 2014.
4. L. S. Negi, Design of Steel Structures, Tata McGraw Hill, 1997.
5. Ramachandra, Design of steel structures, Standard Book House, 1998.

Paper Code: UCE 711   **Credit: 04**
Paper Name: Soil Stabilization andGround Improvement Techniques   **L-T-P: 2-0-0**
Contact Hours: 24

Module 1: Introduction   Contact Hours: 06
Introduction to ground improvement, classification of various ground improvement technique; feasibility of different ground improvement technique, In-situ densification methods in cohesionless and cohesive soils

Module 2: Soil Stabilization   Contact Hours: 06
Mechanical Stabilization, cement stabilization, lime stabilization, types and properties, proportioning techniques, etc., mechanism, factors affecting, design of mixtures, construction methods.

Module 3: Grouting   Contact Hours: 04
Introduction; Kinds of grout- Cementitious grouts and Chemical grouts; Grouting methods, Intrusion grouting, Permeation grouting, compaction grouting and jet grouting.

Module 4: Soil Reinforcement   Contact Hours: 04
Using strips, geogrids, geotextiles, and geomembrane.

Module 5: Dewatering   Contact Hours: 04
Methods of dewatering and pressure relief, well point systems, deep well drainage, vacuum dewatering, electro osmosis, capacity of pumps and pumps design, installation and operation of dewatering systems – single line, two line, flow to a single well, multiple well systems. Soil nailing, underpinning, tunneling.

Text/Reference Books:

1. Foundation Engineering by J. Bowles, McGraw Hills International.
2. Designing with Geosynthetics by Robert M. Koerner, Prentice Hall Englewood Cliff, NJ.
3. Foundation Engineering by Leonard, McGraw Hill Book 10. New York.

Paper Code: UCE 712   **Credit: 04**
Paper Name: Highway Construction Practice   **L-T-P: 2-0-0**
Contact Hours: 24

Module 1: Flexible Pavement   **Contact Hours: 06**
Flexible Pavement Construction: Earthwork, compaction and construction of embankments, specifications of materials, construction methods and field control checks for various types of flexible pavement materials in sub-base, base, binder and surface course layers and their choice.

Module 2: Rigid Pavement   **Contact Hours: 06**
Cement Concrete Pavement Layers: Specifications and method of cement concrete pavement construction; Construction of interlocking block pavements, Quality control tests; Construction of various types of joint.

Module 3: Soil Stabilized Pavement   **Contact Hours: 06**
Soil Stabilized Pavement Layers: Principles of gradation/proportioning of soil- aggregate mixes and compaction; Design factors, mix design, construction control and quality control checks for mechanical, soil-cement, soil-bitumen and soil-lime stabilization methods. Use of additives, Numerical problems on mix design and applications.

Module 4: Pavement Evaluation   **Contact Hours: 06**
Pavement Evaluation - Pavement Distress - Functional and structural condition of pavements, Functional condition evaluation of pavements- Roughness, Skid Resistance. Pavement strengthening based on deflection as per IRC, Maintenance and rehabilitation techniques.

Text/Reference Books:
1. Highway Engineering, S.K. Khanna and C.E.G. Justo, Nem Chand and Bros. Roorkee.
2. Principles of Transportation Engineering,P. Chakraborty, PHI Learning.
3. Construction Equipment and its Management, S. C. Sharma, Khanna Publishers.
4. Textbook of Highway Engineering,R. Srinivasa Kumar, Universities Press.
5. Highway Engineering, Paul H. Wright and Karen K. Dixon, seventh Edition, Wiley Student Edition.

Paper Code: UCE713   **Credit: 4**
Paper Name: Structural Repair and Rehabilitation   **L-T-P: 2-0-0**
Total contact hours: 24

Module 1: Evaluation of structural health   **Contact hours: 8**

Basics: Difference between Retrofitting, Repair and Rehabilitation of RCC structures, Importance of repair and rehabilitation.

Causes of distress and deterioration: Accidental and excess loading, quality issues in construction, chemical reactions, corrosion, freezing and thawing, settlement and movement, shrinkage, temperature changes.

Evaluation of concrete in concrete structures: Site survey and assessment, cracking, disintegration and spalling, scaling, dusting, distortion, erosion, seepage, crack survey, joint inspections, physical and chemical analysis, Non-Destructive Testing.

Module 2: Materials and methods for repair and rehabilitation   **Contact hours: 8**

Planning and design of concrete repair, Autogenous healing, crack arrest techniques, drilling and plugging, Fibre reinforced concrete, flexible sealing, gravity soak, chemical grouting, hydraulic-cement grouting, jacketing, polymer overlays, polymer coating, polymer injection, polymer concrete, shotcrete, judicious neglect, shrinkage-compensating concrete.

Specialized repairs: rehabbing lock walls, blasting lock walls, anchors, pre-placed aggregate concrete, cut-off walls, under water repairs, geomembrane work.

Module 3: Maintenance of concrete   **Contact hours: 2**
Stains and stain removal, cleaning details, oil stains, grease, dirt, mildew, asphalt, efflorescence, coating and sealing compounds.

Module 4: Trouble shooting defects in concrete   **Contact hours: 2**
Excess water, bad design data, chemical attacks, alkali-aggregate reaction, freezing, moving water and cavitation.

Module 5: Costing, tendering and execution of repair and rehabilitationContact hours: 4
Difficulties and uncertainties in the estimation of costs of repair and rehabilitation, estimation of repair and rehabilitation works, tendering of repair and rehabilitation works, Special Conditions of Contract for repair and rehabilitation works. Care to be taken during repair and rehabilitation works, Cost control.

Text/ Reference Books:
1. *Repair Of Concrete Structures. Allen R.T.L. John Willey andSons, 1987.*
2. *RCC Design. S.N. Sinha. Tata McGraw-Hill PublishingLtd., 2002*
3. *Handbook on repair and rehabilitation of RCC buildings. CPWD, Government of India, 2002.*
4. *R. Dodge Woodson. Concrete Structures: Protection, Repair and Rehabilitation. Elsevier publications, 2009.*
5. *Rehabilitation. B. Sivagnanam. Indian concrete journal, Vol.76, December 2002.*
6. *http://www.structural.net/Repair/repair_concrete.html*
7. *http://www.icivilengineer.com/Structural_Engineering/Structure_Maintenance/*

Subject Code: UCE 714
Subject Name: Irrigation Engineering   **Credit: 04**
Total hours: 24   **L-T-P: 2-0-0**

Module1: Introduction   **Contact Hours: 02**
Definition, necessity, types, advantages and disadvantages of irrigation

Module2: Soil Water-plant Relationship   **Contact Hours: 04**
Soil-water plant relationship, soil-fertility and crop rotation, crop-water relationship, manure and fertilizers for improving soil characteristics, principal crops in India. Water-requirements of Crops.

Module3: Flow Irrigation   **Contact Hours: 06**
Unlined canal-Lacey's theory, design of canal based on silt theory; Lined canal-necessity of lining, selection of lining, types of canal lining and their brief description, design consideration for line canal, maintenance of irrigation canals, Economical considerations of lining a canal.

Module4: Water-logging   **Contact Hours: 02**
Definition, adverse effects of water-logging, causes of water-logging, anti-water logging measures, Drainage system design.

Module5: Canal Head Works   **Contact Hours: 04**

Definition of diversion works and storage weirs and barrages, general layout and the components of head-words, Application of Khosla's theory of independent variables

Module6: Canal fall   **Contact Hours: 03**

Necessity and location, types of fall, component of fall, design of fall with hydraulic consideration-vertical drop fall and glacis fall.

Module7: Cross Drainage Works   **Contact Hours: 03**

Necessity, types of cross drainage work, selection of suitable type of cross drainage works. Design principles only.

Text/Reference Books:

1. Irrigation and Water power Engg. by Punmia, Pande & Lal Laxmi Pub. (P) Ltd, New Delhi.
2. Irrigation & Water Power Engg. by P.N. Modi & S.M. Seth. Standard Book House 1960.
3. Irrigation Engg. & Hydraulic by S.K. Garg, Khanna Pub., Delhi.
4. Structures Irrigation Engg. by GL Asawa, Willey Eastern Ltd.

Paper Code: UCE715   **Credit: 04**
Paper Name: Sustainable Construction Methods   **L-T-P: 2-0-0**
Total contact hours: 24

Module 1: Sustainability in Building Environment   **Contact hours: 6**

Sustainable development relative to ecological, economic and social conditions – efforts in sustainable development and construction – international organisations involved; Ethics and sustainability: environmental and resource concerns – resource consumption by construction industry – Green building movement' Ecological design – concept – major contributions; Building assessment and eco labels – standards (LEED, GRIHA) – assessment structure and process; Green building design process – documentation requirements.

Module 2: Sustainable site and landscape   **Contact hours: 4**

Assessment of sustainable sites. Building energy issues: building energy design strategy – building envelope – internal load reduction – energy optimisation – renewable energy systems; Carbon footprint and measures for reducing carbon footprint; Built environment hydrologic cycle – water resources issues – strategies for conservation and recycling – waste water and storm water handling strategies; Construction Waste Management.

Module 3: Engineering Materials for Sustainability   **Contact hours: 4**

Environmental impact of materials; life-cycle assessment – embodied energy;materialselectiontooptimizeperformance;design,evaluation,andproductionof green constructionmaterials and products – assessing for environmental impacts – design for deconstruction – LEED credits for different aspects.

Module 4: Sustainable Development and Environmental Laws   **Contact hours: 6**

Sustainable development and environment - United Nations Sustainable Development Goals (SDGs); Environment and governance; Understanding climate change, carbon crediting etc., Introduction to trade and environment; Environmental laws and policies; Right to Environment as HumanRight.

Text/ Reference Books:

8. *Sustainable Building Design Manual – Volume II, The Energy Research Institute, New Delhi, 2004.*
9. *Sustainable Construction: Green Building Design and Delivery. C. J. Kibert. John Wiley & Sons, 2013.*
10. *Introduction to Architectural Science – The Basis of Sustainable Design. Steven V. Szokolay, Elsevier, 2007.*
11. *Sustainable Construction. Sandy Halliday, Routledge, Taylor & Francis Group, 2013.*
12. *A Handbook of Sustainable Building Design and Engineering. Dejan Mumovic and Mat Santamouris (Ed), Earthscan Publishing, 2009.*
13. *Green Architecture: Advanced Technologies and Materials. Osman Attmann, McGraw Hill, 2010.*

Paper Code: UCE 716   **Credit: 04**
Paper Name: Pavement Analysis and Design   **L-T-P: 2-0-0**
Contact Hours: 24

Module 1: Introduction   **Contact Hours: 06**
Desirable characteristics of pavement, Types and components, Functions of sub grade, sub base, base course, surface course, Comparison between rigid and flexible pavement, Fundamentals of Design of pavements: Stresses and deflections, Principle, Assumptions and Limitations of Boussinesq's theory, Burmister theory and problems on above.

Module 2: Design Factors   **Contact Hours: 06**
Design wheel load, contact pressure, Design life, Traffic factors, climatic factors, Road geometry, Subgrade strength and drainage, ESWL concept Determination of ESWL by equivalent deflection criteria, Stress criteria, EWL concept, and problems on above.

Module 3: Flexible Pavement   **Contact Hours: 06**
Flexible pavement Design: CBR method, CSA method using IRC-37, Types of failures, Causes, Remedial/Maintenance measures in flexible pavements, Functional Evaluation by Visual inspection and unevenness measurements, Structural evaluation by Benkleman beam deflection method, Falling weight deflectometer, GPR method. Problems on above.

Module 4: Rigid Pavement   **Contact Hours: 06**
Types of stress, Analysis of Stresses, Westergaard's Analysis, Modified Westergaard equations, Critical stresses, Wheel load stresses, Warping stress, Frictional stress, combined stresses (using chart / equations). Design of CC pavement by IRC: 58. Design of Dowel bars, Design of Tie bars, Types of failures, causes, remedial/maintenance measures in rigid pavements.

Text/Reference Books:

1. Highway Engineering, S.K. Khanna and C.E.G. Justo, Nem Chand and Bros. Roorkee.
2. Principles of Transportation Engineering,P. Chakraborty, PHI Learning.
3. Principles of pavement design, Yoder and Witezak¸ John Wiley and sons.
4. Textbook of Highway Engineering,R. Srinivasa Kumar, Universities Press.
5. Highway Engineering, Paul H. Wright and Karen K. Dixon, seventh Edition, Wiley Student Edition.
6. Design of functional pavements, Yang, Mc Graw –Hill.

Subject Code: UCE 717   **Credit: 04**
Paper Name: Open Channel Flow   **L-T-P: 2-0-0**
Total Contact Hours: 24

Module 1: Basic Flow Concepts   **Contact Hours: 03**

Types of channels, Classification of flow, Basic equations, Velocity distribution-velocity coefficients, Pressure distribution in a vertical. Energy and Momentum Principles, Specific energy, Critical flow, Specific force, Simple channel transitions.

Module 2: Uniform flow   **Contact Hours: 05**
Uniform Flow in Rigid-Boundary Channels, Shear stress on boundary, Velocity distribution in turbulent flow, Chezy's equation, Manning's equation, Conveyance of a channel section, Section factor for uniform flow computation, Second hydraulic exponent, Computation of uniform flow.

Module 3: Uniform flow in mobile-Boundary Channels   **Contact Hours: 05**
Incipient motion condition – Shield's analysis, Regimes of flow, Prediction of regimes, Flow resistance. Design of Channels, Rigid boundary channels, non-scouring erodible boundary channels, Alluvial channels.

Module 4: Gradually Varied Flow   **Contact Hours: 05**
Differential equation of GVF, Classification of flow profiles, Analysis of flow profiles, Computation of GVF – direct integration, simple numerical integration for prismatic and non-prismatic channels. GVUF – Basics of St. Venant's equations, Method of characteristics

Module 5: Hydraulic Jump   **Contact Hours: 06**
Types of jump, Characteristics of jump, General equation for jumps in prismatic channels, Jump in horizontal and sloping rectangular channels. Rapidly Varied Flow, Flow over sharp crested weirs, broad crested weirs, spillways, Flow under sluice gate, Brink depth. Unsteady Flow, Waves – celerity of small gravity wave, RVUF – surges in open channels.

Text/Reference Books:

1. Flow in Open Channel by K. Subramanya, Tata McGraw Hill, New Delhi.
2. Open Channel Hydraulics by V.T. Chow, McGraw Hill, New York.
3. Open Channel Hydraulics by R.H. Ftrench, McGraw Hill, New York.
4. Open Channel Flow by M.H. Chaudhry, Prentice-Hall of India, New Delhi.
5. Flow through Open Channels by K.G. Ranga Raju, Tata McGraw Hill, New Delhi.
6. Open Channel flow by Madan Mohan Das. PHI Learning Pvt. Ltd., 2008.

Paper Code: UCE718   **Credit: 04**
Paper Name: Optimization Techniques in Engineering   **L-T-P: 2-0-0**
Total contact hours: 24

Module 1: Introduction to optimizationContact hours: 6

Engineering Applications of Optimization, Statement of an Optimization Problem, Design Constraints, Constraint Surface, Objective Function, Efficiency Criteria; calibration, verification and validation Optimization Techniques, single and multi-objective optimization; Sustainable and optimal allocation of resources; Economic and Econometric principles, Cost and Benefit Curves.

Module 2: Linear programming   **Contact hours: 4**

Applications, Standard form, Simplex method, Primal- Dual Relations, Transportation Problem, Integer Linear Programming. Assignment Problem.

Module 3: Dynamic Programming   **Contact hours: 4**
Multistage Decision Processes, Concept of Sub-optimization and principle of Optimality, Computational Procedure in Dynamic Programming, Design of a Minimum-Cost Drainage System. Water allocation problem, capacity expansion problem, reservoir operation, case study.

Module 4: Nonlinear Programming   **Contact hours: 4**

Unrestricted Search, Exhaustive Search, Dichotomous Search, Interval Halving Method, Golden Section Search Method, Interpolation Method, Quadratic Interpolation Method, Cubic Interpolation Method, Direct Root Method.

Module 5: Engineering applications of optimization   Contact hours: 6
Optimal design and operation of systems, such as reservoir for irrigation and power production, river water quality. Water supply and drainage network optimization, road layout in transportation engineering, site layout for building projects, etc.; alternatives assessment; software tools and programs available for optimization.

Text/Reference Books:

1. *Engineering Optimization - Theory and Optimization. S.S. Rao. New Age International Publishers.*
2. *Operations Research. P.K. Gupta, and D.S. Hira. S. Chand Publishing. 7e, 1976.*
3. *Encyclopaedia of Optimization- Volume 2. A. Floudas and M. Perdolas. Springer, USA.*
4. *Introduction to Linear and Nonlinear Programming. D.G. Luenberger Addison Wesley, Menlo Park,(CA), 1984.*
5. *Optimization for Engineering Design: Algorithms and Examples. K. Deb. PHI Pvt Ltd.*
6. *Optimization In Civil and Environmental Engineering. Z.W Geem. Old City Publishing, USA.*
7. *Environmental System Optimization. A.H. Douglas. John Wiley and Sons, New York.*
8. *Water Resources Systems: Modeling Techniques and Analysis. S. Vedula and p.p. Mujumdar. Tata McGraw-Hill Publisher.*

Paper Code: UCE719   Credit:04
Paper Name: DISASTER MANAGEMENT   L-T-P: 2-0-0
Total contact hours: 24

Module I:Definition and Types of Disaster   Contact Hours: 06
Hazards and Disasters, Risk and Vulnerability in Disasters, Natural and Man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

Module II:Study of Important Disasters   Contact Hours: 06
Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landside and its managements case studies of disasters in Sikkim (e.g) Earthquakes, Landside). Social Economics and Environmental impact of disasters.

Module III:Mitigation and Management Techniques of Disaster   Contact Hours: 06
Basic principles of disasters management, Disaster Management cycle, Disaster management policy, National and State Bodies for Disaster Management, Early Warming Systems, Building design and construction in highly seismic zones, retrofitting of buildings.

Module IV:Disaster Management in India   Contact Hours: 06
Disaster Profile of India – Mega Disasters of India and Lessons Learnt Disaster Management Act 2005 – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national),Non-Government and Inter-Governmental Agencies

Text/Reference Books:

1. *Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012)*
2. *Introduction to International Disaster Management by Damon, P. Copola, (2006) Butterworth Heineman.*

3. *Disaster management and Risk Reduction, Role of Environmental Knowledge by Gupta A.K., Nair S.S and Chatterjee S. (2013), Narosa Publishing House, Delhi.*
4. *Disaster Management by Murthy D.B.N. (2012) Deep and Deep Publication PVT. Ltd. New Delhi. 5. Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LTD.*

Paper Code: UCE720   **Credit: 04**
Paper Name: Structural Analysis-III   **L-T-P: 2-0-0**
Total contact hours: 24

Module 1: Analysis of Building Frame: **Contact Hours: 10**
Approximate Method, Substitute Frame Method, Portal Method and Cantilever method.

Module 2: Matrix Methods of Structural Analysis   **Contact Hours: 07**
Introduction to Matrix Methods-Flexibility Methods, Application to beams, plane trusses and plane rigid frames.

Module 3:Plastic Method of Structural Analysis   **Contact Hours: 07**
Concept of redistribution of internal forces, Shape factor, Collapse mechanisms, Collapse Load of beams, Plastic moment distribution.

Text/Reference Books:

1. *Theory of Structures by S. Ramamrutham and R. Narayan, Dhanpat Rai Publishing Company.*
2. *Matrix Method of Structural Analysis by W. Weaver and J.M. Gere, CBS Publication.*
3. *Strength of Materials by S. Timoshenko, McGraw Hill.*
4. *Plastic methods of Structural Analysis by B.G. Neal, Champian and Hall.*

B.Tech Civil Engineering Syllabus Details

Semester VIII

Paper Code: UCE801   **Credit: 06**
Paper Name: Construction Engineering and Project Management   **L-T-P: 2-1-0**
Total contact hours: 36

Module 1: Basics of construction and Construction methods   Contact Hours: 06

Unique features of construction, construction projects- types and features, phases of a project, agencies involved and their methods of execution.

Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls; Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges.

Module 2: Construction equipment   Contact Hours: 06

Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing, concrete pumping; Cranes, Hoists and other equipment for lifting; Guniting & shortcreting;, shoring & underpinning; slipform and trenchless technologies; Equipment for transportation of materials. Equipment Productivities.

Module 3: Planning and organizing construction site and resources   Contact Hours: 06
Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Resource Scheduling- Bar chart, line of balance technique, resource constraints & conflicts; common Good Practices in Construction.

Module 4: Construction project planning   Contact Hours: 06

Construction project planning- Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, early & late time calculations, computation of float values, critical and semi critical paths, calendaring networks; PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion.

Module 5: Project monitoring and control   Contact Hours: 06

Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM); Quality control: concept of quality, use of manuals and checklists for quality control, role of inspection. Safety, Health and Environment on project sites: occupational health problems in construction.

Module 6:Basics of bidding and contract management   **Contact Hours: 06**
Importance of contracts; Types of Contracts, parties to a contract; tender & agreements, acceptance of tenders, earnest money & security deposits; Competitive bidding in construction industry: bidding strategy; common contract clauses; Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, breach of contracts; Dispute Resolution methods: arbitration.

Text/Reference Books:

14.Building construction. P.C. Varghese. Prentice Hall India, 2007.
15.PERT and CPM Principles and Applications. L.S. Sreenath. East-West Press.
16.Construction Engineering & Management. S. Seetharaman. Umesh Publication.
17.Construction Technology. R. Chudley. ELBS Publishers, 2007.
18.Construction Planning, Methods and Equipment. R.L. Peurifoy. McGraw Hill, 2011
19.Construction Methods and Management. S.W. Nunnally. Prentice Hall, 2006
20.National Building Code. Bureau of Indian Standards, New Delhi, 2017.
21.Construction Project management, Theory & Practice. N.K. Jha. Pearson Education India,
22.Construction Equipment its Planning land Application. M. Verma. Metropolitan Book Co.
23.Project Planning with PERT and CPM. B.C. Punmia and K.K. Khandelwal. Laxmi Publications, 2016.

Paper Code: UCE802   **Credit:06**
Paper Name: Structural Analysis-III   **L-T-P: 3-0-0**
Total Contact hours: 36

Module-I: Introduction   **Contact Hour:02**
Review of Limit state method of Design and comparison of limit state method with other method.

Module-II: Loads and Lateral Load Analysis   **Contact Hour:06**
Staircase, Lateral load analysis – portal and cantilever method, Transfer of load from slab to beams equivalent load, continuous beams.

Module-III: Water Tanks   **Contact Hour:08**
Circular, rectangular, overhead and underground tanks including intake tank, staging, IS code method.

Module-IV: Prestressed Concrete   **Contact Hour:10**
Concept, IS code requirements (IS:1343) systems of prestressing, losses, simple design. Concept of Design of end block Magnate and Battens method.

Module-V: Steel & Timber   **Contact Hour:10**
Steel Bridges – pedestrian truss bridge. Industrial Building – Trusses, Portal, Knee braces. Water tank- pressed steel tank and staging. Timber structures – IS Code requirements, classification of timber, Beams, columns, lamination, joints. Crane girder and gantry girder.

Text/Reference Books:
1. Adv. Reinforced Concrete Design by N. Krishna Raju, CBS Publishers and Distributors, Delhi.
2. Prestressed Concrete by Krishna Raju, Tata McGraw Hill, New Delhi.

3. Design of Steel Structures (Vol. I & II) by Ram Chandra, Standard Book House, Delhi.
4. Masonry & Timber Structures by A.s. Arya, Nem Chand & Brothers, Roorkee

Paper Code: UCE811   **Credit: 04**
Paper Name: Bridge Engineering   **L-T-P: 2-0-0**
Total contact hours: 24

Module 1: Introduction: **Contact Hours: 02**
Importance of site investigation in Bridge design, Highway Bridge loading standards, Impact factor, Railway Bridge loading standards

Module 2: Box Culvert: **Contact Hours: 02**
General aspects, Design loads, Design of box culvert subjected to RC class AA tracked vehicle only

Module 3: Bridge Bearings: **Contact Hours: 02**
General features-Types of Bearings-Design principles of steel Rocker and Roller Bearings- Design of steel Rockier Bearing-Design of elastometric pad Bearing.

Module 4: Deck Slab Bridge: **Contact Hours: 04**
Introduction-Effective width method of Analysis Design of deck Slab Bridge (Simply supported) subjected to class AA Tracked Vehicle only.

Module 5: Beam & Slab Bridge (T-Beam Bridge):   **Contact Hours: 04**
General features-Design of interior panel of slab – Pigeauds method – Design of a T-beam bridge subjected to class AA tracked vehicle only

Module 6: Plate Girder Bridge: **Contact Hours: 04**
Introduction – elements of a plate girder and their design. Design of a Deck type welded plate girder- Bridge of single line B.G.

Module 7: Composite Bridge: **Contact Hours: 04**
Introduction-Advantages-Design philosophy of composite bridges consisting of RC slabs over steel girders including shear connectors.

Module 8: Piers & Abutments: **Contact Hours: 02**
General features - Bed Block - Materials piers and Abutment types of piers – Forces acting on piers, Stability analysis of piers- General features of Abutments – forces acting on abutments, Stability analysis of abutments – Types of wing walls, Approaches.

Text/Reference Books:

1. Essentials of Bridge Engineering by Victor D.J., Oxford and IBH Publishing Company Pvt. Ltd.
2. Design of Bridge Structure by T. R. Jagadish & M. A. Jayaram, Prentice Hall of India Pvt. Ltd.
3. Design of Bridges by N. Krishna Raju, Oxford and IBH Publishing Company Pvt. Ltd.
4. Bridge Engineering by Ponnusawmy, Tata McGraw Hill Company, New Delhi
5. Relevant – IRC & Railway bridges Codes

Paper Code: UCE812   **Credit: 04**

Paper Name: Advance Foundation Engineering   **L-T-P: 2-0-0**
Total contact hours: 24

Module 1: Soil Exploration   **Contact Hours: 06**
Planning, Concept of significant depth, spacing and number of boreholes, types of samples and samplers, SPT, CPT – plate load test, vane shear test, geophysical investigations.

Module 2: Shallow Foundations   **Contact Hours: 06**
Footings on layered soil, footings subjected to uplift. Design of strap footing, combined footing, rafts, floating rafts.

Module 3: Pile Foundations   **Contact Hours: 04**
Bearing capacity and settlement of axially loaded piles, laterally loaded piles.

Module 4: Sheet Piling   **Contact Hours: 04**
Uses, common types, design of cantilever sheet pile in granular and cohesive soils, Anchored bulkheads, methods of reducing lateral pressure.

Module 5: Soil Dynamics   **Contact Hours: 04**
Determination of dynamic soil properties, natural frequency, design of foundations for reciprocating and impact type machines, vibration isolation.

Text/Reference Books:

1. Foundation Engg. by S.P. Brahma, Tata McGraw Hills, New Delhi.
2. Foundation Engg. by J. Bowles, McGraw Hills International
3. Hand book of machine foundation by Srinivasulu, Tata McGraw Hill, New Delhi.

Paper Code: UCE813   **Credit: 04**
Paper Name: Environmental Impact Assessment   **L-T-P:2-0-0**
Total Contact Hour: 24

Module 1: Introduction   **Contact Hour: 04**
HistoricaldevelopmentofEnvironmentalImpactAssessment(EIA).EIAinProjectCycle.LegalandRegulatoryaspectsinIndia.– Typesandlimitations ofEIA–CrosssectoralissuesandtermsofreferenceinEIA– Public ParticipationinEIA.EIAprocess-screening–scoping-setting–analysis– mitigation

Module 2: ComponentsandMethodsforEIA   **Contact Hour: 05**
Matrices – Networks – Checklists – Connections and combinations of processes - Cost benefit analysis – Analysis of alternatives – Software packagesforEIA–ExpertsystemsinEIA.PredictiontoolsforEIA– Mathematicalmodelingforimpactprediction–Assessmentofimpacts–air–   water–soil–noise–biological— CumulativeImpactAssessment–   DocumentationofEIAfindings–planning–organizationofinformationand visualdisplaymaterials–Reportpreparation.EIAmethodsinothercountries.

Module 3: Socio-EconomicImpactAssessment   **Contact Hour: 05**
Definition of social impact assessment. Social impact assessment modeland theplanningprocess.RationaleandmeasurementforSIAvariables. Relationship between social impacts and change in community and institutionalarrangements.Individualandfamilylevelimpacts.Communities in transition - neighborhood and community impacts. Selecting, testing and understanding significant social impacts. Mitigation and enhancement in socialassessment.Environmentalcostingofprojects

**Module 4*: Environmental ManagementPlan*   *Contact Hour: 04*
Environmental Management Plan - preparation, implementation andreview-MitigationandRehabilitationPlans– Policyandguidelinesforplanningand   monitoringprograms–Postprojectaudit–EthicalandQualityaspectsof

EnvironmentalImpactAssessment.

Module 5: *SectoralEIA*   ***Contact Hour: 06***

EIArelatedtothefollowingsectors-Infrastructure–constructionandhousing   Mining–Industrial-ThermalPower-RivervalleyandHydroelectric–coastal projects-NuclearPower.EIAforcoastalprojects.

Text/Reference Books:

1.   Lawrence,D.P.,EnvironmentalImpactAssessment–Practicalsolutionsto   recurrentproblems,Wiley-Interscience,NewJersey,2003.
2. Petts,J.,HandbookofEnvironmentalImpactAssessment,Vol.,IandII, Blackwell Science, London,1999.
3. Canter,L.W.,EnvironmentalImpactAssessment,McGrawHill,NewYork. 1996.

Paper Code: UCE 814   **Credit: 04**
Paper Name: Design of Substructures   **L-T-P: 2-0-0**
Total contact hours: 24

Module 1: Foundation Design   **Contact Hours: 04**
Types of foundations, Selection of types of foundations, Basic requirements of foundations, Design steps.

Module 2: Shallow Foundation   **Contact Hours: 04**
Settlement of footings, structural design.

Module 3: Deep foundation   **Contact Hours: 04**
Introduction, Classification of piles based on materials, Bearing capacity of piles, Pile load tests, Penetration tests, Negative skin friction, Cassions, Depth of well foundation and bearing capacity, forces acting on well foundation, well sinking.

Module 4: Design of retaining wall   **Contact hours: 06**
Introduction, Rankine and Coulomb formula application to retaining walls, Properties of retaining walls, Stability of retaining walls.

Module 5: Machine Foundation   **Contact Hours: 06**
Soil dynamics, spring mass system, forced vibrations, natural frequency of foundation soil system, Dynamic analysis of block foundations.

Text/Reference Books:

1. Analysis and design of substructures, Swami Saran, Oxford & IBH
2. Foundation analysis and design, Bowles, Mc Grew Hill.
3. Foundation Design, Donald P. Coduto, Pearson.

Paper Code: UCE 815   **Credit: 04**
Paper Name: Geometric Design of Transportation Facilities **L-T-P: 2-0-0**
Contact Hours: 24

Module 1: Introduction   **Contact Hours: 02**
Geometric Control factors like Topography –designspeed – design vehicle – Traffic volume – environment andother factors-PCU concept.

Module 2: Cross sectional elements   **Contact Hours: 06**

Pavement surface characteristics –friction – skid resistance – pavement unevenness- light reflecting characteristics – camber – carriage way – kerb – median –shoulder – foot path – parking lanes – service roads – cycle tracks –Driveways – Right of way – Factors influencing right of way.

Module 3: Sight Distance   **Contact Hours: 02**
Stopping sight distance, Overtaking sight distance, Sight distance at uncontrolled intersection, Derivation, Factors affecting sight distance, Numerical problems.

Module4: Horizontal and Vertical Alignment   **Contact Hours: 06**
Ruling minimumand absolute minimum radius, Super elevation – Extra widening of pavement on curves – Transition curve –set back distance on horizontal curve.Gradient – Types of gradient – Design criteriaof summit and valley curve – Design of vertical curves– Design standards for hilly roads –problems on the above.

Module 5:Intersection Design   **Contact Hours: 06**
Principle – Atgrade and Grade separatedjunctions – Types – channelization –. Rotary Intersection: Elements – Advantages – Disadvantages –Design Guidelines– Grade separated intersection –Three legged inter section – Diamond inter change – Half cloverleaf – cloverleaf- Advantages- Disadvantages.

Module 5:Mass transportation systems   **Contact Hours: 02**
Mass transportation –requirements, characteristics, advantages and disadvantages. Metro rail projects, Bullet train.

Text/Reference Books:
1. Highway Engineering, S.K. Khanna and C.E.G. Justo, Nem Chand and Bros. Roorkee.
2. Principles of Transportation Engineering,P. Chakraborty, PHI Learning.
3. Textbook of Highway Engineering,R. Srinivasa Kumar, Universities Press.
4. Highway Engineering, Paul H. Wright and Karen K. Dixon, seventh Edition, Wiley Student Edition.

Paper Code: UCE 816   **Credit: 04**
Paper Name: Traffic Engineering   **L-T-P: 2-0-0**
Contact Hours: 24

Module 1: Introduction   **Contact Hours: 02**
3E's of traffic Engineering, Problems related to heterogeneous traffic in developing nations, Passenger Car Unit.

Module 2: Traffic Characteristics   **Contact Hours: 04**
Road user characteristics, Vehicular characteristics, Traffic flow characteristics, Capacity, Traffic studies and traffic survey, Volume, Spot speed, Speed and delay, Origin and destination, Parking and accident study.

Module 3: Traffic Operations   **Contact Hours: 10**
Conflict points on one and two way streets, Traffic control devices, Signs, Signals, Islands and markings, Design of isolated traffic signals by IRC method.

Module4: Road Safety   **Contact Hours: 04**
Analysis of traffic accidents, Highway lighting, Effect of road conditions and road geometrics on traffic safety, Traffic safety awareness.

Module 5:Environmental Impact   **Contact Hours: 04**
Noise pollution, Air pollution, Environmental Impact Assessment.

Text/Reference Books:

1. Highway Engineering- S. K. Khanna & C.E.G Justo, Nem Chand & Bros.
2. Traffic Engineering and Transport Planning – Kadiyali, L.R. (Khanna Publishers, Delhi
3. Traffic Engineering – McShane, W.R. and Roes, R.P. (Prentice Hall, New Jersey)
4 Traffic Engineering - Theory & Practice - Louis J. Pignataro, Prentice Hall Publication
5. Traffic Flow Fundamentals – May, A.D. (Prentice Hall, Englewood Cliffs, New Jersey)

Paper Code: UCE 817   **Credit: 04**
Paper Name: Finite Element & Analysis   **L-T-P: 2-0-0**
Contact Hours: 24

Module1: Introduction   **Contact Hours: 04**
Basic theory of finite Element method, application of finite element method, Advantages and disadvantages.

Module2: Elasticity   **Contact Hours: 04**
Elasticity Theory, displacements and strains, stress transformations, strain transformation, Equilibrium, Compatibility, constitutive law, boundary conditions, Plane stress, plane strain,

Module 3: Energy Variational Principles and Ritz techniques   **Contact Hours: 04**
Work, energy and their complementary counterparts, Principle of virtual work,Energy principles, Rayleigh-Ritz method, Matrix algebra and Gaussian elimination.

Module4: Element properties   **Contact Hours: 04**
Displacement models, convergence requirements, shape functions, element strains and stresses, element stiffness matrix, Isoparametric elements

Module5: One dimensional Problems   **Contact Hours: 04**
Finite element modelling, co-ordinates and shape functions, the potential energy approach, Galerkin approach, Global stiffness, Load vectors, quadratic shape functions

Module6 Two Dimensional Stress Analysis   **Contact Hours: 04**
Structural idealization, Triangular elements, rectangular element, displacements in terms of nodal displacements

Text/Reference Books:

1. Introduction to finite Elements in Engineering by T.K. Chandrupatia and A.D. Belegundu, Prentice Hall of India Pvt. Ltd.
2. Finite Element analysis (Theory & Programming) by C.S. Krishnamurthy, Tata McGraw Hill Publishing Co. Ltd.
3. Finite Element analysis in Engineering Design- S. Rajasekharan, Wheeler Publishing, Allabahad.
4. Finite Element methods by K.S. Bathe and E.L. Wilson, Prentice Hall of India.
5. Finite Element Methods in Engineering Sciences-by O.C. Zeinkiewicz, McGraw Hill Book Co

Paper Code -UCE818   **Credit : 04**
Paper Name: Earthquake Resistant Structures   **L-T-P: 2-0-0**
Total Contact Hours: 24

Module 1   **Contact Hour: 05**
Engineering Seismology: Terminologies (Focus, Focal depth, Epicenter, etc.); Causes of Earthquakes; Theory of plate tectonics; Types and characteristics faults; Classification of Earthquakes; Major past earthquakes and their consequences; Types and characteristics of seismic waves; Magnitude and intensity of earthquakes; local

site effects; Earthquake ground motion characteristics: Amplitude, frequency and duration; Seismic zoning map of India; (Problems on computation of wave velocities. Location of epicentre, Magnitude of earthquake).

Module 2   **Contact Hour: 04**
Response Spectrum: Basics of structural dynamics; Free and forced vibration of SDOF system; Effect of frequency of input motion and Resonance; Numerical evaluation of response of SDOF system (Linear acceleration method), Earthquake Response spectrum: Definition, construction, Characteristics and application; Elastic design spectrum.

Module 3   **Contact Hour: 05**
Seismic Performance of Buildings and Over View of IS-1893 (Part-1): Types of damages to building observed during past earthquakes; Plan irregularities; mass irregularity; stiffness irregularity; Concept of soft and weak storey; Tensional irregularity and its consequences; configuration problems; continuous load path; Architectural aspects of earthquake resistant buildings; Lateral load resistant systems. Seismic design philosophy; Structural modeling; Code based seismic design methods.

Module 4   **Contact Hour: 04**
Determination of Design Lateral Forces: Equivalent lateral force procedure and dynamic analysis procedure. Step by step procedures for seismic analysis of RC buildings using Equivalent static lateral force method and response spectrum methods.

Module 5   **Contact Hour: 06**
Earthquake Resistant Analysis and Design of RC Buildings: Typical failures of RC frame structures, Ductility in Reinforced Concrete, Design of Ductile Reinforced Concrete Beams, Seismic Design of Ductile Reinforced Concrete column, Concept of weak beam-strong column, Detailing of Beam-Column Joints to enhance ductility, Detailing as per IS-13920. Retrofitting of RC buildings.

Text/Reference Books:

1. Earthquake resistant design of structures: Pankaj Agarwal and Manish Shrikande, PHI India.
2. Earthquake Resistant Design of Structures: S.K. Duggal, Oxford University Press
3. Dynamics of Structures: Theory and Applications to Earthquake Engineering: Anil K. Chopra, Pearson Education, Inc.
4. Seismic Analysis of Structures: T. K. Datta, John Wiley & Sons (Asia) Ltd.
5. Earthquake resistant design and risk reduction: David Dowrick, John Wiley and Sons Ltd.
6. Some Concepts in Earthquake: C. V. R. Murty, Rupen Goswami, A. R. Vijayanarayanan & Vipul V. Mehta
7. IS-13920 – 2016, Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces, BIS, New Delhi
8. IS-1893 – 2016, Indian Standard Criteria for Earthquake Resistant Design of Structures, Part-1, BIS, New Delhi
9. IS-3935 – 1993, Repair and Seismic Strengthening of Buildings-Guidelines, BIS, New Delhi.

Central Institute of Technology Kokrajhar
Dept. of Computer Science and Engineering

B. Tech Syllabus (6th Semester)

Subject Code	Subject Name	Type	L	T	P	C
UCSE601	Compiler Design	Compulsory	4	0	0	8
UCSE602	Software Engineering	Compulsory	3	0	0	6
UCSE603	Machine Learning	Compulsory	3	0	0	6
UCSE611	Computer Graphics	Professional Elective II	3	0	0	6
UCSE612	Internet of Things		3	0	0	6
UCSE613	Speech and Natural Language Processing		3	0	0	6
UCSE614	VLSI System Design		3	0	0	6
UHSS601	Professional Communication	Compulsory	2	0	0	4
UCSE671	Compiler Design Laboratory	Compulsory	0	0	3	3
UCSE672	Software Engineering Laboratory	Compulsory	0	0	3	3
UCSE673	Machine Learning Lab	Compulsory	0	0	3	3
UCSE691	Mini Project		0	0	3	3
Total Contact Hours			15	0	12	42

Detailed Syllabus

Compiler Design (UCSE601)

L-T-P: 4-0-0
Credits: 8
Total lectures: 60 Hours

Prerequisites: Formal Language and Automata Theory (UCSE503)

Module 1: Overview of Compilation [4L]
Phases of Compilation – Lexical Analysis, Regular Grammar and regular expression for common programming language features, pass and Phases of translation, interpretation, bootstrapping, data structures in compilation – LEX lexical analyzer generator.

Module 2: Top down Parsing [4L]
Context free grammars, Top down parsing – Backtracking, LL (1), recursive, descent parsing, Predictive parsing, and Preprocessing steps required for predictive parsing.

Module 3: Bottom up Parsing [15L]
Shift Reduce parsing, LR and LALR parsing, Error recovery in parsing, handling ambiguous grammar, YACC – automatic parser generator.

Module 4: Semantic Analysis [12L]
Intermediate forms of source Programs – abstract syntax tree, polish notation and three address codes. Attributed grammars, Syntax directed translation, Conversion of popular Programming languages language Constructs into Intermediate code forms, Type checker.

Module 5: Symbol Tables [5L]
Symbol table format, organization for block structures languages, hashing, tree structures representation of scope information. Block structures and non-block structure storage allocation: static, Runtime stack and heap storage allocation, storage allocation for arrays, strings and records.

Module 6: Code Optimization [10L]
Consideration for Optimization, Scope of Optimization, local optimization, loop optimization, frequency reduction, folding, DAG representation, Flow graph, data flow equation, global optimization, redundant sub expression elimination, Induction variable elimination, Live variable analysis, Constant propagation.

Module 6: Object Code Generation [10L]
Object code forms, machine dependent code optimization, register allocation and assignment generic code generation algorithms, DAG for register allocation.

TEXT BOOKS:
1. Compilers Principles, Techniques and Tools — Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, 2nd edition, Pearson Education, 2007

REFERENCES:
1. Principles of compiler design — Alfred V. Aho, Jeffrey D. Ullman, Indian student edition, Pearson Education, 2001.
2. Compiler Construction– Principles and Practice — Kenneth C. Louden, 1st edition, PWS Publishing, 1997.
3. Modern Compiler Implementation C — Andrew W. Appel, Cambridge University Press, 2004.
4. Modern Compiler Design — Dick Grune, Henry E. Bal, Cariel T. H. Jacobs, Wiley dreamtech.
5. Theory of computer science- Automata Languages and computation — K. L. P Mishra, N.Chandrashekaran, 2nd edition, Prentice Hall of India, 2003

Software Engineering (UCSE602)

L-T-P: 3-0-0
Credits: 6
Total lectures: 36 Hours

Module 1: Introduction to Software Engineering [10L]
The evolving role of software, Changing Nature of Software, Software myths. A Generic view of process: Software engineering- A layered technology, a process framework, The Capability Maturity Model Integration

(CMMI), Process patterns, process assessment, personal and team process models. Process models: The waterfall model, Incremental process models, Evolutionary process models, specialized process models, The Unified process.

Module 2: Software Requirements [4L]
Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management.

Module 3: Project Planning [4L]
Overview, Effort Estimation and COCOMO, project Scheduling, Risk Management, Monitoring Plan.

Module 4: Design Engineering [6L]
Design process and Design quality, Design concepts, the design model. Cohesion and Coupling. Golden rules, User interface analysis and design, interface analysis, interface design steps, Design evaluation.

Module 5: Testing Strategies [4L]
A strategic approach to software testing, test strategies for conventional software, Black-Box and White-Box testing, Validation testing, System testing, the art of Debugging. Software Quality, Metrics for Analysis Model, Metrics for Design Model, Metrics for source code, Metrics for testing, Metrics for maintenance.

Module 6: Risk management [4L]
Reactive vs Proactive Risk strategies, software risks, Risk identification, Risk projection, Risk refinement, RMMM, RMMM Plan.

Module 7: Quality Management [4L]
Quality concepts, Software quality assurance, Software Reviews, Formal technical reviews, Statistical Software quality Assurance, Software reliability, The ISO 9000 quality standards.

TEXT BOOKS:
1. Rajib Mall, Fundamentals of Software Engineering, PHI, (2005).
2. Pankaj Jalote, Software Engineering, A Precise Approach, Wiley India, (2010).
3. Roger S Pressman, Software Engineering: A practitioner's Approach, McGraw Hill International Edition.

REFERENCES:
1. Waman S Jawadekar, Software Engineering: A Primer, Tata McGraw-Hill, (2008).
2. Deepak Jain, Software Engineering, Principles and Practices, Oxford University Press.

Machine Learning (UCSE603)

L-T-P: 3-0-0
Credits: 6
Total lectures: 30 Hours

Module 1: Introduction to Machine learning [3L]

Brief Introduction to Machine Learning, its advantage and disadvantages, Supervised Learning Unsupervised Learning Reinforcement Learning.

Module 2: Bayesian Learning [5L]
Probability Basics, Bayes Theorem, Naive Bayes Classifier, Gaussian Naive Bayes Classifier, Bayesian Networks.

Module 3: Artificial Neural Network [5L]
Perceptron Learning Algorithm: Delta Rule and Gradient Descent. Multi-layer Perceptron Learning: Backpropagation and Stochastic Gradient Descent. Hypotheses Space, Inductive Bias and Convergence. Variants Structures of Neural Network.

Module 4: Support Vector Machines [4L]
Decision Boundary and Support Vector: Optimization and Primal-Dual Problem. Extension to SVM: Soft Margin and Non-linear Decision Boundary. Kernel Functions and Radial Basis Functions (detailed later).

Module 5: Linear Models and Regression [3L]
Linear Regression. Linear Classification. Logistic Regression. Non-linear Transformation.

Module 6: Decision Tree Learning [4L]
Decision Tree Representation and Learning Algorithm (ID3). Attribute Selection using Entropy Measures and Gains.Hypotheses Space and Inductive bias.

Module 7: Clustering [5L]
Partitional Clustering and Hierarchical Clustering. Cluster Types, Attributes and Salient Features. k-Means, k-Nearest Neighbour (kNN) Classifier. Hierarchical and Density-based Clustering Algorithms. Inter and Intra Clustering Similarity, Cohesion and Separation.

Module 8: Some Other Learning Concept [1L]
Active Learning, Deep Learning, Transfer Learning.

TEXT BOOKS:
1. Christopher Bishop. Pattern Recognition and Machine Learning. 2e.
2. The Elements of Statistical Learning Data Mining, Inference, and Prediction by T. Hastie, R. Tibshirani, J. Friedman

REFERENCES:
1. Machine Learning, Tom Mitchell, McGraw Hill, 1997
2. Introduction to Machine Learning, Third edition, EthemAlpaydin, The MIT Press, September 2014.
3. Understanding Machine Learning: From Theory to Algorithms, First Edition by Shwartz, Shai Ben-David, Cambridge University Press, 2014.
4. Learning From Data, First Edition by Yaser S. Abu-Mostafa, Malik Magdon-Ismail, Hsuan-Tien Lin, AML Book, 2012.

Computer Graphics (UCSE611)

L-T-P: 3-0-0
Credits: 6
Total lectures: 30 Hours

Module 1: Introduction to Computer Graphics [3L]
Application areas of Computer Graphics, Similarity and difference with Image Processing and Computer Vision, Overview of graphics systems, video-display devices, raster-scan systems, random scan systems, graphics monitors, Concept of Pixel, Image, Colour.

Module 2: Output Primitives [5L]
Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms. Polygon, convex polygon, inside outside test. Filled area primitives: Scan line polygon fill algorithm, boundary-fill and flood-fill algorithms.

Module 3: 2-D Geometrical Transforms [5L]
Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, affine transformation, rigid body transformation, composite transforms, transformations between coordinate systems.

Module 4: 2-D Viewing [4L]
The viewing pipeline, viewing coordinate reference frame, window to view-port coordinate transformation, viewing functions, Cohen-Sutherland, Cyrus-beck and Liang-Barsky line clipping algorithms.

Module 5: Curve and Curve Surface [5L]
Continuity, algebraic, tangent, curvature continuity.Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and B-Spline curves, Bezier and B-Spline surfaces. Basic illumination models, polygon rendering methods.

Module 6: 3-D Geometric Transformations and Viewing [4L]
Translation, rotation, scaling, reflection and shear transformations, composite transformations. Viewing pipeline, viewing coordinates, view volume and general projection transforms and clipping.

Module 7: Visible Surface Detection [3L]
Classification, back-face detection, depth-buffer, scan-line, depth sorting, BSP-tree methods, area sub-division and octree methods.

Module 8: Computer Animation [1L]
Design of animation sequence, general computer animation functions, raster animation, computer animation languages, key frame systems, motion specifications.

TEXT BOOKS:
1. "Computer Graphics C version", Donald Hearn and M.Pauline Baker, Pearson Education.
2. "Computer Graphics Principles & practice", second edition in C, Foley, VanDam, Feiner and Hughes, Pearson Education.

REFERENCES:
1. Computer Graphics, Second Edition, Donald Hearn and M.Pauline Baker, PHI/Pearson Education.
2. Computer Graphics Second Edition, Zhigand Xiang, Roy Plastock, Schaum's outlines, Tata Mcgraw hill edition.
3. Procedural Elements of Computer Graphics, David Rogers, Tata Mc Graw hill, 2nd edition.
4. Principles of Interactive Computer Graphics, Neuman and Sproul, TMH.
5. Principles of Computer Graphics, ShaliniGovil, Pai, 2005, Springer.
6. Computer Graphics, Steven Harrington, TMH

Internet of Things (UCSE612)

L-T-P: 6-0-0
Credits: 6
Total lectures: 44 Hours

Prerequisites: Computer Network (UCSE501)

Module 1: Introduction to IoT [12L]
Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Communication models & APIs, Communication technologies: LoRa WAN, BLE, Zigbee, 802.15.4. Protocols: 6LOWPAN, RPL, CoAP and MQTT.

Module 2: IoT Reference Architecture [6L]
Getting Familiar with IoT Architecture, Various architectural views of IoT such as Functional, Information, Operational and Deployment. Constraints affecting design in IoT world- Introduction, Technical design Constraints.

Module 3: Developing IoT solutions [12L]
Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi, Introduction to SDN, SDN for IoT, Data Handling and Analytics, Cloud Computing, Fog and Edge Computing, Introduction to Mobile Edge Computing (MEC).

Module 4: Applications of IoT[8L]
Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Introduction to Inustry 4.0, an Industrial IoT, Case Study: Agriculture, Healthcare.

Module 5: Privacy and Security Issues in IoT [6L]
IoT attack model, Network, physical, and software attacks, privacy leakage, DoS attacks, Man-in-the-middle attack, access control for IoT systems, Secure IoT offloading, IoT malware.

TEXT BOOKS:
1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-onApproach)", 1st Edition, VPT, 2014.

2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.

REFERENCES:
1. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
2. CunoPfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493- 9357-
3. Hassan, Qusay F., ed. Internet of things A to Z: technologies and applications. John Wiley & Sons, 2018.

Speech and Natural Language Processing (UCSE613)

L-T-P: 3-0-0
Credits: 6
Total lectures: 45 Hours

Module 1: Introduction to Speech and NLP [6L]
Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production; NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning.

Module 2: Linguistic Resource and Speech Analysis [7L]
Introduction to corpus, elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNetetc, Resource management with XML, Management of linguistic data with the help of GATE, NLTK Introduction to Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log Spectral Distance.

Module 3: Speech and Text Modelling [10L]
The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, BaumWelch Parameter Re-estimation, Implementation issues. Part Of Speech Tagging and Sequence Labelling. Large Vocabulary Continuous Speech Recognition: Architecture of large vocabulary continuous speech recognition system

Module 4: Syntactic and Semantic Analysis [6L]
Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs. Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labelling and Semantic Parsing.

Module 5: Text-to-Speech Synthesis [8L]

Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status. Module 6: Information Extraction (IE) and Machine Translation (MT) for Speech and NLP [no of lectures 8] Named entity recognition and relation extraction. IE using sequence labelling. Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars.

TEXT BOOKS:
1. Lawrence RabinerandBiing-Hwang Juang, "Fundamentals of Speech Recognition", Pearson Education, 2003.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education.
3. Christopher D. Manning and HinrichSchuetze ―Foundations of Statistical Natural Language Processing‖, MIT Press, 1999.

REFERENCES:
1. Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing", California Technical Publishing.
2. Thomas F Quatieri, "Discrete-Time Speech Signal Processing – Principles and Practice", Pearson Education. Claudio Becchetti and Lucio PrinaRicotti, "Speech Recognition", John Wiley and Sons, 1999.
3. Ben gold and Nelson Morgan, "Speech and audio signal processing", processing and perception of speech and music, Wiley- India Edition, 2006 Edition.
4. Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press 6.
5. Steven Bird, Ewan Klein and Edward Loper ―Natural Language Processing with Python‖, O'Reilly Media; 1 edition, 2009.

VLSI System Design (UCSE614)

L-T-P: 3-0-0
Credits: 6
Total lectures: 35 Hours

Prerequisites: Digital Electronics and Logic Design (UECE306)

Module 1: Introduction [5L]
History, future trends in VLSI design, Basic flows in VLSI design

Module 2: VLSI Design for Power and Speed [6L]
Design of first CMOS circuits, power dissipation in a VLSI circuit – static and dynamic, power estimation, power minimization.

Module 3: Data Path Design [4L]
Different strategies for arithmetic implementation in a VLSI circuit.

Module 4: Interconnect Design [5L]
Effect of scaling, buffer insertion and inductive peaking, low swing and current mode signalling, capacitive coupled interconnect.

Module 5: HDL for VLSI Design [7L]
Introduction to Verilog/VHDL, basic components, structural description and behavioural description.

Module 6: VLSI Test [4L]
Introduction to testing, automatic test pattern generations, DFT, BIST.

Module 7: VLSI Verification [4L]
Introduction, equivalence checking, model checking

TEXT BOOKS:
1. Principles of CMOS VLSI Design - Weste and Eshranghian, Second Edition, Pearson Education, India;
2. Low Power CMOS VLSI Circuit Design - Kaushik Roy, Wiley- Interscience.
3. Modern VLSI Design - Wayne Wolf, Third Edition, Pearson Education.
4. The designer's guide to VHDL - Peter J. Ashenden, Second Edition, Morgan and Kaufmann/Harcourt India.
5. Verilog HDL - SamirPalnitkar, Low Price Edition, Pearson Education, Asia.
6. VLSI Test Principles and Architectures - L.W. Wang, C.W. Wu, W.Xioqing, Academic Press, 2006.
7. Hardware Design Verification - William Lam, Prentice Hall.

REFERENCES:
1. Digital Integrated Circuits - Jan M. Rabaey, AnantChandrakasan, and BorivojeNikoli, Prentice Hall (India).
2. Logics in Computer Science - M. Huth and M. Ryan, Cambridge University Press.

Professional Communication (HU601)

L-T-P: 2-0-0
Credits: 02

Oral Communication: Aims at improving the oral communication skills. Public speaking skills, features of effective speech - verbal - nonverbal, Presentation skills, Group discussion Mock Interviews.

Written Communication Focuses on improving the writing skills. A review of grammar, transformation of sentences; reading comprehension; Precis-writing, skills to express ideas through various kinds of essays; business administrative and E-correspondence, business reports, technical documentation & project proposal writing and CVs/ resumes; Application letters, Notices, Agenda, Minutes & Memos. Case Analysis.

Organization Communication Attempts to acquaint students with tie process and requirements of communication in organizations. It includes the objectives of communication, Channels of communication, Bathers in Communication, Non-verbal & Cross-cultural communication, Meetings, Conferences, Press Conference and Press release. Business communication Technology Audio-Visual aids, Internet, e-nail. Creative communication Slogan-writing, Advertisement.

Texts/ References:
1. Wren & Martin., English Grammar.
2. John Metchell., Howto write Reports.
3. MarkMcCormack, Communication.
4. Rajendra Pal & J.S. Korlahalli, Essentials of Business Communication.

Compiler Design Laboratory (UCSE671)

L-T-P: 0-0-3
Credits: 3
Total lectures: 45 Hours

Prerequisites: Programming for Problem Solving LAB (UCSE271) and Data Structures and Algorithms LAB (UCSE371)

LIST OF EXPERIMENTS:

1. Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces, tabs and new lines. It should also ignore comments. Although the syntax specification states that identifiers can be arbitrarily long, you may restrict the length to some reasonable value. Simulate the same in C language.
2. Write a C program to identify whether a given line is a comment or not.
3. Write a C program to test whether a given identifier is valid or not.
4. Write a C program to simulate lexical analyzer for validating operators.
5. To Study about Lexical Analyzer Generator (LEX) and Flex(Fast Lexical Analyzer).
6. Implement following programs using Lex.
7. Create a Lexer to take input from text file and count no of characters, no. of lines & no. of words.
8. Write a Lex program to count number of vowels and consonants in a given input string.
9. Implement following programs using Lex.
10. Write a Lex program to print out all numbers from the given file.
11. Write a Lex program to printout all HTML tags in file.
12. Write a Lex program which adds line numbers to the given file and display the same onto the standard output.
13. Write a Lex program to count the number of comment lines in a given C program. Also eliminate them and copy that program into separate file.
14. Write a Lex program that copies a file, replacing each nonempty sequence of white space by a single blank.
15. Write a Lex program that copies a C program, replacing each instance of the keyword float with double.
16. Write a Lex program which will modify the words in the following way:
17. If the first letter is a consonant, move it to the end of the word and then add ay.
18. If the first letter is a vowel, just add ay to the end of the word.
19. Write a Lex program to identify identifiers from a given input source file.
20. Write a Lex program to count the number of vowels and consonants from an input file and write the results to a file.
21. Write a Lex program to count the number of lines in a given input source file.

22. Write a Lex program to count the number of comment lines in a c program. Also eliminate that comment line. (input read from file).
23. Write a Lex program to identify correctly an inputted 8 bit binary number.
24. Write a lex program to find out all the tokens from the following input C program.
    (input read from file)
    int main()
    {
    // 2 variables
    int a, b;
    a = 10;
    return 0;
    }

25. Write a lex program to count the number of tokens and find out all the tokens from the following input C program. (input read from file)
    int main()
    {
    int a = 10, b = 20, c;
    c=a+b;
    printf("sum is :%d",c);
    return 0;
    }

26. Write a C program to implement the transition diagram for
    Unsigned numbers
    Integers
    Real numbers
    Identifiers
    Relational operators
27. Write a lex program to identify all the numbers in an input text and then perform the sum of the numbers.
28. Write a lex program to count the number of the word "the" in an input text.
29. Write a lex program to count the number of stopwords and remove all of them.
30. Write a Lex program to design a simple calculator.
31. Write a lex program to count the number of palindromes present in a input text and write them to a separate text file.
32. Write a lex program to check valid arithmetic expressions.
33. Write a lex program to find the length of an input text.
34. Write a lex program to reverse all the words in an input text.
35. Write a lex program to find the smallest word in an input text.
36. Write a lex program to convert lowercase characters to uppercase.
37. Write a lex program to sort all the words in an input text as per their length.
38. Write a C program for implementing the functionalities of predictive parser for the mini language.
39. Write a C program for constructing of LL (1) parsing.
40. Write a Yacc program for sentence checking.
41. Write a Yacc program for Calculator.

Software Engineering Lab (UCSE672)

L-T-P: 0-0-3
Credits: 3

List of Experiments
1. Do the following exercises for any two projects given in the list of sample projects or any other projects:
2. Write down the problem statement for a suggested system of relevance.
3. Do requirement analysis and develop Software Requirement Specification Sheet (SRS) for suggested system.
4. To perform the function oriented diagram: Data Flow Diagram (DFD) and Structured chart.
5. To perform the user's view analysis for the suggested system: Use case diagram.
6. To draw the structural view diagram for the system: Class diagram, object diagram.
7. To draw the behavioral view diagram : State-chart diagram, Activity diagram
8. To perform the behavioral view diagram for the suggested system : Sequence diagram, Collaboration diagram
9. To perform the implementation view diagram: Component diagram for the system.
10. To perform the environmental view diagram: Deployment diagram for the system.
11. To perform various testing using the testing tool unit testing, integration testing for a sample code of the suggested system.
12. Perform Estimation of effort using FP Estimation for chosen system.
13. To prepare time line chart/Gantt Chart/PERT Chart for selected software project.

Sample Projects:
1. Passport automation System
2. Bank management system
3. Online Exam Registration
4. Stock Maintenance System
5. Online course reservation system
6. E-ticketing
7. Software Personnel Management System
8. Credit Card Processing
9. E-book management System.
10. Recruitment system

TEXT BOOKS:
1. Rajib Mall, Fundamentals of Software Engineering, PHI, (2005).
2. Pankaj Jalote, Software Engineering, A Precise Approach, Wiley India, (2010).
3. Roger S Pressman, Software Engineering: A practitioner's Approach, McGraw Hill International Edition.

REFERENCES:
1. Waman S Jawadekar, Software Engineering: A Primer, Tata McGraw-Hill, (2008).

2. Deepak Jain, Software Engineering, Principles and Practices, Oxford University Press.

Machine Learning Lab (UCSE673)

L-T-P: 0-0-3
Credits: 3

Prerequisites: Machine Learning (UCSE603)

List of experiments

1) Import the data from .txt, .csv file

2) Convert a text file or CSV file and CSV to txt file

3) Implement the Linear Regression. Logistic Regression

4) Implement K-nearest neighbours classification

5) Implement K-Means clustering

6) Implement the classification using: SVM, Neural Network, Naive Bayes Classifier, Decision Tree, Random Forest.

7) Implement the Hidden Markov Model for sequence tagging

Project

1) Generate 100 points in two dimensions randomly. For example, (2, 3), (28, 13), …… Assign the point (x, y) in class 1 if x > y otherwise assign it in class 2. Implement all the classifiers given in No 6 above. Test the classifiers with any points.

2) Collect all the data of your class like (age, height, weight), Implement the linear regression with the data and find your weight using the age and height.

3) The iris flowers have different species and using suitable classifier distinguish them based on the length of petals and sepals. The detail description of the data and data repository is at "https://archive.ics.uci.edu/ml/datasets/Iris"

4) Create / collect a data set on fake news in your mother tongue. Using this data set train a suitable classifier to detect fake news.

5) Collet the SBI stock price in daily basis in the last year. Develop a technique to find the pick point. Implement a predictive model using this data.

TEXT BOOKS:

1. Introduction to Machine Learning with Python A Guide for Data Scientists By Andreas C. Müller, Sarah Guido, O'Reilly Media, 2016
2. Machine Learning in Python Essential Techniques for Predictive Analysis by Michael Bowles, Wiley, 2015

B. Tech Syllabus (7th Semester)

Subject Code	Subject Name	Type	L	T	P	C
UCSE701	Advance Algorithm	Compulsory	3	0	0	6
UCSE711	Parallel Computing	Professional Elective III	3	0	0	6
UCSE712	Embedded System		3	0	0	6
UCSE713	Neural Network and Deep Learning		3	0	0	6
UCSE714	Cryptography and Network Security		3	0	0	6
UCSE715	Digital Image Processing	Professional Elective IV	3	0	0	6
UCSE716	Ad-hoc and Sensor Network		3	0	0	6
UCSE717	Pattern Recognition		3	0	0	6
UCSE718	Human Computer Interaction		3	0	0	6
UCSE719	History of Science and Engineering	Open Elective I	3	0	0	6
UCSE791	Major Project I	Compulsory	0	0	8	8
UCSE792	Industrial Training	Compulsory	0	0	0	2
Total Contact Hours			12	0	8	32

Advance Algorithm (UCSE701)

L-T-P: 6-0-0
Credits: 6
Total lectures: 40 Hours

Prerequisites: Design & Analysis of Algorithms (UCSE403)

Module 1: Introduction [6L]
Complexity analysis,emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis. different classes of problems, P, NP, NP Complete, NP Hard, Cooks Theorem, reduction with example.

Module 2: Graph & Tree [6L]
Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path. Floyd-Warshall algorithm and introduction to dynamic programming paradigm, AVL Tree, Red Black Tree.

Module 3: Matroids [6L]
Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set, application to MST.

Module 4: Flow-Networks [5L]
Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.

Module 5: LP and SDP-based approximation algorithms[6L]
LP Duality, set cover using dual fitting, LP rounding techniques, Sparsest cut, Facility location, Semidefinite programming, Max-cut.

Module 6: Approximate Counting and Sampling [6L]
Concept of self-reducibility, Markov Chain Monte Carlo method, Vertex-cover and TSP, TSP with 1.5-approximation.

Module 7: Geometric Algorithms [5L]
Some preliminaries, Convex Hull, Segment intersection, Closest-pair, Voronoi-Delaunay diagrams, Flip algorithm

TEXT BOOKS:
1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Approximation Algorithms" Vijay V. Vazirani, Springer-Verlag, Berlin.

REFERENCES:
1. "Algorithm Design" by Kleinberg and Tardos.
2. "The Design of Approximation Algorithms", David P. Williamson and David B. Shmoys, Cambridge University Press, New York.

Parallel Computing (UCSE711)

L-T-P: 3-0-0
Credits: 6
Total lectures: 35 Hours

Prerequisites: Computer Organization and Architecture (UCSE401)

Module 1: Introduction [4L]
Demands, pipelining vs parallelism, scalability, the sieve of Eratosthenes, Amdhals' law.

Module 2: PRAM Algorithms [6L]
Serial computational model, PRAM model, algorithms: prefix sum, list ranking, merging of two sorted arrays, and reduction of processors.

Module 3: Multi Processors [5L]
Processor network: mesh, binary tree, hyper tree, pyramid, butterfly etc, UMA vs NUMA, Flynn's taxonomy.

Module 4: Mapping and Scheduling [6L]

Mapping data to processor on processor array and multicomputer: Ring to 2D mesh, 2D mesh to 2D mesh, complete binary tree to 2D mesh, binomial tree to 2D mesh, complete binary tree to hypercube, load balancing in multicomputer, static scheduling on UMA multi processors: Graham's list scheduling algorithm.

Module 5: Matrix Multiplication [5L]
Sequential approach, algorithm for processor arrays, multicomputer, multiprocessors.

Module 6: Sorting [5L]
Odd even transposition sort, bitonic merge sort, parallel quick sort.

Module 7: Parallel Computing Platforms [4L]
Introduction to CUDA.

TEXT BOOKS:
1. Parallel Computing Theory and Practice — Michael J. Quinn, TMG publishers.
2. CUDA C Programming – John Cheng, Max Grossman, Ty McKercher, Wiley publishers.

REFERENCES:
1. Introduction to Parallel Computing - AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar, Pearson publishers.

Embedded System (UCSE712)

L-T-P: 3-0-0
Credits: 6
Total lectures: 42 Hours

Prerequisites: Operating System (UCSE502)

Module 1: Introduction to Embedded Systems [3L]
Embedded Systems, Processor Embedded into a System, Embedded Hardware Units and Devices In a System, Embedded Software in a system, Examples of Embedded Systems, Embedded System-on-chip (SOC) and Use of VLSI Circuit Design Technology, Complex Systems Design and Processors, Design Process in Embedded System, Formulization of System Design, Design Process and Design Examples, Classification of Embedded Systems, Skills Required for an Embedded System Designer.

Module 2: Device and Communication Bus for Devices Network [6L]
IO Types and examples, Serial communication devices, Parallel Device ports, Sophisticated Interfacing Feature in Devices Ports, Wireless Devices, Timer and Counting Devices, Watch dog timer, Real time clock, Network Embedded Systems, Serial Bus Communication Protocols, parallel Bus Devices protocol, Parallel communication Network using ISA, PCI, PCI-X and advanced buses, Internet Enabled Systems- Network protocols, Wireless and mobile system protocol.

Module 3: Device Drivers and Interrupt Services Mechanism [5L]

Programmed-I/O Busy-wait Approach without Interrupt Services Mechanism, ISR Concept, Interrupt Sources, Interrupt Servicing (Handling) Mechanism, Multiple Interrupts, Context and the Periods for Context Switching, Interrupt Latency and Deadline, Classification of Processor Interrupt Service Mechanism from Context-Saving Angle, Direct Memory Access, Device Driver Programming.

Module 4: Inter process Communication and Synchronization of processes, Threads and Tasks [8L]

Multiple process in an application, Multiple Threads in an application, Task and Task state, Task and Data, Clear-cut Distinction between Functions, ISRS and Tasks by their Characteristics, Concept of Semaphores, Shared Data, Inter process Communication, Signal Function, Semaphore Functions, Message Queue Functions, Mailbox Functions, Pipe Functions, Socket Functions, RPC Functions.

Module 5: Real Time Operating System [11L]

Operating system service, Process management, Timer function, Event function, Memory management, Device , File and I/O subsystem management, Interrupt routine in RTOS environment and handling of interrupt Sources calls, Real Time Operating Systems, Basic Design Using an RTOS, RTOS Task Scheduling Models, Interrupt Latency and Response of the Tasks as Performance Metrics, OS Security Issues.

Module 6: Case Study [9L]

Case Study: Motivation for MSP 430 Microcontrollers: MSP430 RISC CPU architecture, Compiler-friendly features, Instruction set, Clock system, Memory subsystem. Understanding of different MSP430 families. Introduction to Code Composer Studio (CCS) and use CCS for Embedded C. Digital I/O – I/O ports programming using C, Understanding the muxing scheme of the MSP430 pins, interrupt programming On-chip peripherals - Watchdog Timer, Basic Timer, Real Time Clock (RTC), ADC, Universal Serial Communication Interface (USCI). Interfacing LED, LCD, Seven segment LED modules interfacing. Example – Real-time clock, Low-power features of MSP430.

TEXT BOOKS:
1. Embedded System: Architecture, Programming and Design by Rajkamal, 2nd edition, 2010, Tata McGraw Hill.
2. MSP430 Microcontroller Basics by John H. Davies Elsevier; First edition (2010).
3. Computer as Components: Principles of Embedded Computing System Design, Wayne Wolf, 2nd edition, 2008, Morgan Kaufmann Publication

REFERENCES:
1. Introduction to Embedded Systems by Shibu K V, Tata McGraw Hill Education Private Limited, 2009.
2. Introduction to Embedded Systems by E. A. Lee and S. A. Seshia, Second Edition, MIT Press, 2017.

Neural Network and Deep Learning (UCSE713)

L-T-P: 3-0-0
Credits: 6
Total lectures: 30 Hours

Prerequisites: Machine learning (UCSE603)

Module 1: Introduction to Neural Network [3L]
Neural Network, Human Brain, Models of an Artificial Neuron and Neural Networks, Network Architectures, Knowledge Representation, Learning Process.

Module 2: Single Layer Perceptron [6L]
Single Layer Perceptron and Model, Convergence Theorem, Limitation of Single Layer Perceptron, XOR Problem, Activation Function.

Module 3: Multilayer Perceptron [8L]
Multilayer Perceptron, Gradient Descent and Back Propagation, Associative Memory, Bidirectional Associative Memory, Self-Organizing Maps, Radial Basis Function Network.

Module 4: Deep Learning [9L]
Fundamental of Deep Learning and Different from Machine Learning, Depp Learning Networks, Recurrent Neural Networks (RNN), Long Short Term Memory (LSTM), Bidirectional LSTMs, Gated Recurrent Units GRU), Convolutional Neural Networks (CNN).

Module 5: Deep Learning applications [4L]
Image Processing, Natural Language Processing, Speech Recognition, Video Analytics.

TEXT BOOKS:
1. Neural Networks, A Comprehensive Foundation, 2nd Edition, by Simon Haykin
2. Deep Learning, Ian Goodfellow and YoshuaBengio and Aaron Courville, MIT Press, 2016.

REFERENCES:
1. Neural Networks and Deep Learning by Michael A. Nielsen, Determination Press 2015
2. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
3. Deep Learning (Adaptive Computation and Machine Learning series) Illustrated Edition by Ian Goodfellow, YoshuaBengio, Aaron Courville.
4. Neural Networks and Deep Learning, 1st ed. 2018 Edition, Kindle Edition by Charu C. Aggarwal

Cryptography and Network Security (UCSE714)

L-T-P: 3-0-0
Credits: 6
Total lectures: 45 Hours

Prerequisites: Computer Networks (UCSE501)

Module 1: Introduction to Network Security [6L]
Preliminary, Key objectives of Security, Security Standards, Security Attacks, Security Services, Security Mechanisms, Cyber Attacks and its motives, vulnerabilities, Defence Strategies and Techniques, Guiding Principles, Model for Network Security and Network Access Model.

Module 2: Mathematical Background for Cryptography [5L]

Modulo Arithmetic, GCD, Euclid Algorithm, Extended Euclid Algorithm, Useful Algebraic Structures (Groups, Ring, Fields, Polynomial Fields), Chinese Remainder Theorem, Prime Numbers, Relatively Prime Numbers, Euler Totient Function, Euler's Theorem.

Module 3: Basics of Cryptography [5L]
Preliminaries, Different Cryptographical Techniques, Secret vs Public Key Cryptography, Elementary Substitution Ciphers, Monoalphabetic Ciphers, Polyalphabetic Ciphers, Elementary Transposition Ciphers, Rail Fence Technique, Cipher Properties – Confusion and Diffusion, Block Ciphers and Stream Ciphers.

Module 4: Secret Key Cryptography [5L]
Product Ciphers, DES Construction, Fiestel Structure, Round Function, Mode of Operation, MAC and other applications.

Module 5: Public Key Cryptography and RSA [5L]
Public Key Cryptosystem, PKI, RSA, Key Generation, Encryption and Decryption, Applications of RSA, Digital Signature, Public Key Cryptography Standards (PKCS).

Module 6: Cryptographic Hash [3L]
Introduction, Properties, Construction, Generic Cryptographic Hash, Case Study of SHA-1, Applications of Hash, Hashed based MAC, Digital Signatures.

Module 7: Discrete Logarithm and its Applications [4L]
Introduction, Diffie-Hellman Key Exchange, Protocol, Attacks, Choice of Diffie-Hellman Parameters, El-Gamal Encryption and El-Gamal based Digital Signature.

Module 8: Elliptic Curve Cryptography and its Application [5L]
Elliptic Curve Operations, ECs over Real, ECs over Prime Fields, ECs over Binary Fields, Discrete Logarithm on Elliptic Curves, Diffie-Hellman Key Exchange on EC Groups, ECC based Encryption/Decryption, ECC based Digital Signature.

Module 9: Key Management [2L]
Introduction, Digital Certificates, Digital Certificate Types, X.509 Digital Certificates, Digital Certificate in Action, Public Key Infrastructure, PKI Architecture, Certificate Revocation.

Module 10: Security at Different Layers of Networking [2L]
IPSec-Security at Network Layer, Security at Transport Layer, Secure Socket Layer (SSL), OpenSSL.

Module 11: Non-Cryptographic and Software Vulnerabilities [3L]
Denial of Service (DoS) and Distributed Denial of Service (DDoS) attacks, Session Hijacking and Spoofing, ARP Spoofing, Pharming Attacks, Wireless LAN Vulnerabilities. Phishing, Buffer Overflow Attacks, Format String Attacks, Cross Site Scripting (XSS) attacks, SQL Injection.

TEXT BOOKS:
1. Network Security and Cryptography — Bernard Menezes, 6th Indian Reprint, Cengage Learning, 2015

REFERENCES:
1. Cryptography and Network Security Principles and Practice — William Stallings, 5th Edition. Prentice Hall, 2011
2. Understanding Cryptography: A Textbook for Students and Practitioners - Christof Paar and Jan Pelzl, Springer, 2014
3. Serious Cryptography: A Practical Introduction to Modern Encryption - Jean-Philippe Aumasson, No Starch Press, 2017

Digital Image Processing (UCSE715)

L-T-P: 3-0-0
Credits: 6
Total lectures: 30 Hours

Module 1: Introduction [4L]
Image Acquisition, fundamental steps in digital image processing, components of image processing system, Examples of fields that use digital image processing, Digital Image Fundamentals: A simple image formation model, image sampling and quantization, basic relationships between pixels

Module 2: Image enhancement [4L]
Image enhancement in the spatial domain: Basic gray-level transformation, histogram processing, enhancement using arithmetic and logic operators, basic spatial filtering, smoothing and sharpening spatial filters, combining the spatial enhancement methods

Module 3: Image restoration [5L]
A model of the image degradation/restoration process, noise models, restoration in the presence of noise–only spatial filtering, Weiner filtering, constrained least squares filtering, geometric transforms; Introduction to the Fourier transform and the frequency domain, estimating the degradation function.

Module 4: Image Compression [3L]
Fundamentals, image compression models, error-free compression, lossypredictive coding, image compression standards

Module 5: Morphological Image Processing [4L]
Preliminaries, dilation, erosion, open and closing, hit or miss transformation, basic morphologic algorithms.

Module 6: Image Segmentation [2L]
Detection of discontinuous, edge linking and boundary detection, thresholding, region–based segmentation

Module 7: Color Image Processing [4L]
Color fundamentals, color models, pseudo color image processing, basics of full–color image processing, color transforms, smoothing and sharpening, color segmentation

Module 8: Object Recognition [4L]

Patterns and patterns classes, recognition based on decision–theoretic methods, matching, optimum statistical classifiers, neural networks, structural methods – matching shape numbers, string matching.

TEXT BOOKS:
1. Digital Image Processing — R.C.Gonzalez and R.E.Wood, 4th Edition, Addison Wesley, 2018.

REFERENCES:
1. Fundamentals of Digital Image Processing — Anil Ku Jain, PHI, 1988
2. Digital Image Processing and Analysis — B.Channda and D.Dutta, 2nd Edition, Prentice Hall, 2011
3. Image Processing, Analysis, and Machine Vision — Milan Sonka, Vaclav Hlavac and Roger Boyle, Fourth Edition, Cengage Learning, 2014.
4. Introduction to Digital Image Processing with Matlab — Alasdair McAndrew, First Edition, Thomson Course Technology, 2004.
5. Computer Vision and Image Processing — Adrian Low, Second Edition, B.S.Publications, 2008.
6. Digital Image Processing using Matlab — RafealC.Gonzalez, Richard E.Woods, Steven L. Eddins, 2nd Edition, Pearson Education, 2010.
7. Digital Image Processing — William K. Prat, Third Edition, John Wiley & Sons, Inc., 2002.

Ad-hoc and Sensor Network (UCSE716)

L-T-P: 3-0-0
Credits: 6
Total lectures: 45 Hours

Prerequisites: Computer Network (UCSE501)

Module 1: Introduction [9L]
Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio propagation Mechanisms – Characteristics of the Wireless Channel -mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs): concepts and architectures. Applications of Ad Hoc and Sensor networks. Design Challenges in Ad hoc and Sensor Networks.

Module 2: Mac protocols for ad hoc wireless networks [9L]
Issues in designing a MAC Protocol- Classification of MAC Protocols- Contention based protocols-Contention based protocols with Reservation Mechanisms- Contention based protocols with Scheduling Mechanisms – Multi channel MAC-IEEE 802.11.

Module 3: Routing protocols and transport layer in ad hoc wireless networks [9L]
Issues in designing a routing and Transport Layer protocol for Ad hoc networks- proactive routing, reactive routing (on-demand), hybrid routing- Classification of Transport Layer solutions-TCP over Ad hoc wireless Networks.

Module 4: Wireless sensor networks (WSNs) and mac protocols [9L]
Single node architecture: hardware and software components of a sensor node – WSN Network architecture: typical network architectures-data relaying and aggregation strategies -MAC layer protocols: self-organizing, Hybrid TDMA/FDMA and CSMA based MAC- IEEE 802.15.4.

Module 5: WSN routing, localization &QoS [9L]
Issues in WSN routing – OLSR- Localization – Indoor and Sensor Network Localization-absolute and relative localization, triangulation-QOS in WSN-Energy Efficient Design-Synchronization-Transport Layer issues.

TEXT BOOKS:
1. C. Siva Ram Murthy, and B. S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, Prentice Hall Professional Technical Reference, 2008.
2. RaminHekmat, Ad-hoc Networks: Fundamental Properties and Network Topologies, Springer , 1st Edition, 2006

REFERENCES:
1. B. Tavli and W. Heinzelman, Mobile Ad Hoc Networks: Energy-Efficient Real-Time Data Communications, Springer , 1st Edition, 2006.
2. G Anastasi, E Ancillotti, R Bernasconi, and E S Biagioni, Multi-Hop Ad Hoc Networks from Theory to Reality, Nova Science Publishers , 2008.

Pattern Recognition (UCSE717)

L-T-P: 3-0-0
Credits: 6
Total lectures: 28 Hours

Module 1: Basic Concepts [4L]
Pattern Recognition Systems, Fundamental Problems in pattern recognition system design, Design concepts and Methodologies: Character recognition, Speech recognition, Finger print Recognition, Pattern Recognition Model.

Module 2: Decision Functions [4L]
Linear Decision functions, Distance functions. Minimum distance and Maximum distance classification, clustering concepts, Cluster seeking algorithms, K- means Algorithms.

Module 3: Baye's Classifier [4L]
Baye's classified decision function for Baye's classifier, Baye's Classifier for normal patterns, Trainable pattern classifiers - deterministic approach, perception, and approach, reward punishment concept.

Module 4: Gradient Approach [3L]
Gradient approach, Gradient Descent algorithms, LMSE Algorithms, Multi category Classification.

Module 5: Trainable Pattern Classifiers [4L]
Trainable pattern classifiers, statistical approach, stochastic approximation methods, Robbin Minro algorithms, increment correction algorithms, LMSE algorithms. Syntactic pattern recognition, formulation - syntax directed recognition - picture descript.

Module 6: Bilevel Image Processing [3L]

Basic concepts of digital distances, distance transform, medial axis transform, component labeling, thinning, morpho-logical processing, extension to grey scale morphology

Module 7: Binarization and Segmentation of Grey Level Images [3L]
Histogram of grey level images, Optimal thresholding using Bayesian classification, multilevel thresholding, Segmentation of grey level images, Water shade algorithm for segmenting grey level image

Module 8: Detection of Edges and Lines in 2d Images [3L]
First order and second order edge operators, multi-scale edge detection, Canny's edge detection algorithm, Hough transform for detecting lines and curves, edge linking

TEXT BOOKS:
1. Pattern Recognition Principles — J.T. Tou, R.C. Gonzalez, Addison Wesley, 1974
2. Pattern Classification — Richard O. Duda, Peter E. Hart and David G. Stork, 2nd Edition, John Wiley, 2006.
3. Pattern Recognition and Machine Learning — C. M. Bishop, Springer, 2009.

REFERENCES:
1. Digital Image Processing — R.C.Gonzalez and R.E.Wood, 4th Edition, Addison Wesley, 2018.
2. Fundamentals of Digital Image Processing — Anil Ku Jain, PHI, 1988
3. Pattern Recognition — S. Theodoridis and K. Koutroumbas, 4th Edition, Academic Press, 2009.demic Press, 2002.
4. Digital Image Processing and Analysis — B.Channda and D.Dutta, 2nd Edition, Prentice Hall, 2011

Human Computer Interaction (UCSE718)

L-T-P: 3-0-0
Credits: 6
Total lectures: 34 Hours

Prerequisites: Software Engineering (UCSE602)

Module 1: Introduction [3L]
User centric design (UCD), genesis, challenges, and trends in HCI.

Module 2: Usability [5L]
Introduction, parameters of usability, Nielson' approach, case study.

Module 3: Computational Perspective of UCD [4L]
Framework for UCD, user centric models, models for user centric computing, taxonomy of different user centric models.

Module 4: Classical Models [5L]
GOMS model, models for individual users.

Module 5: User based Computational Model [5L]
Case study, non-traditional models, learning based model.

Module 6: Empirical Study [7L]
Research questions, improvement of research questions, different variables, experiment design, data analysis, formulation of computational model, case study.

Module 7: Ubiquitous System [5L]
Recent advancements – GUI and above, user centric issues and challenges, user centric computing challenges

TEXT BOOKS:
1. Human-Computer Interaction User Centric Computing for Designing - Samit Bhattacharya, McGrawHill education.
2. Handbook of Human Computer Interaction - edited by Marting G. Helander, Thomas K. Landauer, Prasad V. Prabhu, Elsevier.

REFERENCES:

1. The Encyclopedia of Human-Computer Interaction Adnan   Ahmad et al., Interaction Design Foundation.

History of Science and Engineering (UCSE719)

L-T-P: 3-0-0
Credits: 6
Total lectures: 32 Hours

Module 1: Science in primitive age [2L]
Thinking mode, Use of fire, Cloths, Tools, wheels, farming, calendar, number system.

Module 2: Development in ancient era [4L]
Growth of Indian science in Vedic period, Harappa Mohenjodaro civilization, Development during Aryabhata, Varahamihira, Brahmagupta, Charaka, Sushruta, Panini, Concept of zero. Temple Architecture and Sculpture – Hindu, Buddhist, Jain, Mughal.

Module 3: Development in British period [6L]
Rammohan Roy. Vidyasagar, C.V.Raman, J.C. Bose, MeghnadSaha and SatyendraNath Bose, Prafulla Chandra Roy, P. C. Mahalanobis, Ramanujan.

Module 6: Emerging Fields [5L]
Different emerging fields of science and engineering, five year research plan in India.

Module 7: R & D in India [5L]
Expenditure in R & D, atmanirbharBhart plan, technology mission, activities in different CSIR Labs.

Module 8: Major Areas of Indian Science and Technology [6L]

Aeronautics: History of HAL, achievements of HAL – LCH, Tejas, future plan on AMCA, Kaveri engine.

Space: History of DRDO, contributions of Dr. Vikram Sarabhai, achievements of DRDO – Mangaljan, Agni, Prthvi missile system, contribution of Kalam Sir (Hon. Ex-President of India, Dr. APJ Abdul Kalam), future plan of DRDO.

Module 9: Technology Transfer and Product Development [4L]

Introduction, technology transfer – method and technique, patent filling in India – process.

TEXT BOOKS:

1. KalpanaRajaram, Science and Technology in India, Published and Distributed by Spectrum Books (P) Ltd.
2. Srinivasan, M., Management of Science and Technology (Problems & Prospects), East-West Press (P) Ltd.

REFERENCES:

1. Ramasamy, K.A., and Seshagiri Rao, K., (Eds), Science, Technology and education for Developlemnt, K., Nayudamma Memorial Science Foundation, Chennai – 8.
2. Kohili, G.R., The Role and Impact of Science and Technology in the Development of India, Surjeet Publications.
3. Government of India, Five Year Plans, Planning Commission, New Delhi.
4. Sharma K.D., and Quresh M.A., Science, Technology and Development, Sterling Publications (P) Ltd., New Delhi.

B. Tech Syllabus (8th Semester)

Subject Code	Subject Name	Type	L	T	P	C
UCSE811	Bioinformatics	Professional Elective III	3	0	0	6
UCSE812	Blockchain Technology		3	0	0	6
UCSE813	Information Retrieval		3	0	0	6
UCSE814	Robotics and Computer Vision		3	0	0	6
UCSE815	Cyber law and Ethics	Open Elective I	3	0	0	6
UHSS801	Economic Policies in India	Open Elective II	3	0	0	6
UCSE891	Major Project II	Compulsory	0	0	12	12
Total Contact Hours			12	0	12	36

Bioinformatics (UCSE811)

L-T-P: 6-0-0
Credits: 6
Total lectures: 44 Hours

Prerequisites: Design & Analysis of Algorithms (UCSE403) and Advance Algorithm(UCSE701)

Module 1: Introduction to Bioinformatics [10L]
Definition and application bioinformatics to biological research and a general view about application relating biological research. NCBI different modules: GenBank; OMIM, Taxonomy browser, PubMed; Protein Data Bank (PDB).

Module 2: Sequence analysis [10L]
Introduction to sequence analysis, local and global alignment, pair wise and multiple alignment, sequence alignment algorithm: Needleman and Wunsch algorithm, Smith-Waterman, BLAST, FASTA. Substitution Matrix: PAM and BLOSUM. Introduction to the idea about phylogenetic analysis through multiple sequence alignment: A brief introduction of gene prediction: Prediction of ORF, Promoter. Motif identificationPfam, Prosite.

Module 3: Protein Secondary and tertiary structure prediction [10L]
Chou Fasman method, Hidden markov model and neural networka, Homology Modelling, Structure visualization methods (eg: RASMOL, CHIME) Introduction to energy minimization, QSAR and their relation in drug design.

Module 4:

UNIX command. Perl programming with bioinformatics application, Bio-Perl.

TEXT BOOKS:
1. Xiong.J, Essential Bioinformatics, Cambridge University Press
    2. Ghosh and Mallick, Bioinformatics-Principles and applications Oxford University Press.
    3. James Tisdall, Beginning Perl for Bioinformatics, SPD

REFERENCES:
1. David W. Mount. Bioinformatics: Sequence and Genome Analysis, 2nd Edition, CSHL Press, 2004.
2. Jonathan Pevsner, Bioinformatics and Functional Genomics, 1st Edition, Wiley-Liss, 2003.
3. Cynthia Gibas and Per Jambeck, Introduction to Bioinformatics computer Skills, 2001 SPD
4. Smith, D.W, Biocomputing: informatics and Genome Project, 1994, Academic Press, NY.

Blockchain Technology (UCSE812)

L-T-P: 3-0-0
Credits: 6
Total lectures: 35 Hours

Prerequisites: Cryptography and Network Security (UCSE714)

Module 1: Basic Crypto Primitives [5L]
Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic cryptocurrency.

Module 2: Blockchain Introduction [6L]
Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.

Module 3: Cryptocurrency [6L]
Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin, of Bitcoin, Legal Aspects - Cryptocurrency Exchange, Black Market and Global Economy.

Module 4: Distributed Consensus [6L]
Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

Module 5: Smart Contract [6L]
Definition and Need, Features of Smart Contracts, Life Cycle of a Smart Contract, Introduction to Ethereum Higher-Level Languages, Development Environment..

Module 6: Blockchain Applications [6L]
Internet of Things, Medical Record Management System, E-Governance, Land Registration, Insurance, Agriculture, Grid+-Energy Ecosystem Platform.

TEXT BOOKS/REFERENCES:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

2. Josh Thompsons, "Block Chain: The Block Chain for Beginners- Guide to Block chain Technology and Leveraging Block Chain Programming".

3. Singhal, B., Dhameja, G., & Panda, P. S. (2018). *Beginning Blockchain: A Beginner's guide to building Blockchain solutions*. Apress.

4. Dhillon, V., Metcalf, D., & Hooper, M. (2017). Blockchain enabled applications. *Berkeley, CA: Apress.*

5. Modi, R. (2018). *Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain*. Packt Publishing Ltd.

6. Bahga, A., &Madisetti, V. (2017). *Blockchain applications: a hands-on approach* (p. 380). ArshdeepBahga& Vijay Madisetti..

Information Retrieval (UCSE813)

L-T-P: 3-0-0
Credits: 6
Total lectures: 30 Hours

Module 1:Overview of text retrieval systems [3L]
Boolean retrieval, The term vocabulary and postings lists, Dictionaries and tolerant retrieval, Index construction and compression

Module 2:Retrieval models and implementation: Vector Space Models[5L]
Vector Space Model, TF-IDF Weight, Evaluation in information retrieval

Module 3: Probabilistic models; statistical language models[5L]
Okapi/BM25; Language models, KL-divergence, Smoothing.

Module 4: Text classification & Text clustering [8L]
The text classification problem, Naive Bayes text classification, k- nearest neighbors, Support vector Machine, Feature Selection, K-means algorithm, Hierarchical clustering, DBSCAN algorithm

Module 5: Web search basics, crawling, indexes, Link analysis [6L]
Web Characteristic, Crawling, Web as a graph, Page Rank, Hubs and Authorities.

Module 6: IR applications [3L]
Information extraction, Question answering, Opinion summarization, Social Network

TEXT BOOKS:
1. Introduction to Information Retrieval, by Christopher D. Manning, PrabhakarRaghavan and HinrichSchütze, Cambridge University Press. 2008. http://nlp.stanford.edu/IR-book/information-retrieval-book.html.
2. Statistical Language Models for Information Retrieval(Synthesis Lectures Series on Human Language Technologies), by Cheng Xiang Zhai, Morgan &Claypool Publishers, 2008.

REFERENCES:
1. Natural Language Processing And Information Retrieval by Tanveer Siddiqui and U. S.Tiwary
2. Modern Information Retrieval by Baeza-Yates, Ricardo, Ribeiro-Neto, Berthier.
3. Introduction to Modern Information Retrieval by Gobinda G. Chowdhury.
4. Search Engines: Information Retrieval in Practice by Donald Metzler, Trevor Strohman, and W. Bruce Croft

Robotics and Computer Vision (UCSE814)

L-T-P: 3-0-0
Credits: 6
Total lectures: 30 Hours

Module 1: Introduction to industrial Robotics [3L]
Definition, structure and application areas of Robotics; Introduction to the range of robots currently in use, scope of industrial Robotics, Definition of an Industrial Robot, Need for Industrial Robots with Applications, Fundamentals of Robot Technology, Automation and Robotics.

Module 2: Robot Anatomy and Sensing Techniques [5L]
Robot Anatomy and Work Volume, Precision of movement End effectors and Sensors, Robot Common sensing Sensor and Techniques, Attributes of sensor, Design of Sensor Suite.

Module 3: Robot Programming [4L]
Robot Programming and Methods, Interlocks textual languages, Characteristics of Robot level languages, characteristics of task level languages.

Module 4: Kinematics [5L]
Direct kinematics of the robot arm, link description and its connection; Frame assignment; Concept of actuator space, joint space and Cartesian space; Inverse kinematics, algebraic solution, geometric solution; Solvabilitly considerations and examples.

Module 5: Robot Controller and Manipulator [5L]

Puma Robot Arm Control, Computed Torque Technique,Near minimum time control, Variable structure control, Non-linear decoupled feedback control, Reserved motion control, Adaptive control.

Manipulator dynamics, basic equations, Newton-Euler dynamic formulation; Lagrange formulation of the manipulator dynamics; Simulation.

Module 5: Robot Cell Design and Control [2L]
Robot Cell Design and control, Remote center Compliance, Safety in Robotics.

Module 6: Computer Vision [5L]
Digital image fundamentals, digitization and 2-D parameters, types of operation; Basic tools: Convolution, Fourier transforms and statistical approaches.Image analysis and processing, basic enhancement and restoration techniques, unsharp masking, noise suppression, distortion suppression, segmentation, thresholding, edge finding, binary mathematical morphology, grey-value mathematical morphology, Stereo Geometry, Motion Analysis.

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Module 7: Advancements in Robotics[1L]
Advanced Robotics, Advanced Robotics in Space, Specific features of Space Robotics systems, Long term technical developments, Advanced Robotics in underwater operations, Robotics Technology of the future and Future applications

TEXT BOOKS:
1. Elements of Industrial Robotics — Barry Leatham Jones, Pitman Publishing, 1987

REFERENCES:
1. Industrial Robotics Technology, Programming And Applications — Mikell P. Groover, Mitchell Weiss, Roger N.Nagel, Nicholas G. Odrey, McGraw Hill Book Company, 1987.
2. Robotics – Control, Sensing, Vision and Applications — Fu K.S., Gonzalez R.C and Lee C.S.G., McGraw Hill International Editions, 1987.
3. Digital Image Processing — Pratt, W.K., 2nd Edition, John Wiley & Sons, 1991.
4. Industrial Robotics — Bernard Hodges and Paul Hallam, British Library Cataloging in Publication, 1990.
5. Modeling and Control of Robot Manipulators — Sciavicco, L., McGraw-Hill, 2003.
6. Robotic Engineering An Integrated Approach — Klafter, R.D., Chmielewski, T.A. and Negin, M., Prentice-Hall of India, 2007.
7. Fundamental of Robotics: Analysis and Control — Schilling, R. J., Prentice-Hall of India, 2007

Cyber law and Ethics (UCSE815)

L-T-P: 3-0-0
Credits: 6
Total lectures: 35 Hours

Prerequisites: Cryptography and Network Security

Module 1: Introduction [4L]
Evolution of cyber space,Cyber laws and rights in today's digital age, Web space, Web hosting and Web Development agreement, Legal and Technological Significance of Domain Names, overview of Government Regulation of the Internet

Module 2: Information Technology Act [6L]

Overview of IT Act, Amendments and Limitations of IT Act, Electronic Governance, Legal Recognition of Electronic Records, Digital Signature, Legal recognition of Digital Signature, Certifying Authorities, Network Service Providers' liability, Cyber Regulations Appellate Tribunal, Cyber-crime and offences, Penalties and Adjudication

Module 3: Intellectual property law [5L]

Overview of intellectual property issues related to use and management of digital data, Patent Law, Trademark Law, Copyright Law, Software Ownership, Domain Names and Copyright disputes, Electronic Data Base and its Protection

Module 4: Personal Privacy Protection and Regulation[3L]

Privacy and Social Media, Ethics of Personal Privacy Online

Module 5: Cyber Crimes[6L]

Software Piracy, Computer Sabotage, Electronic Break-Ins, State and Federal Laws regulating data breaches and responses to data breaches, Cyber Bullying and Cyber Shaming, Hate Speech and its control

Module 6: Information Warfare[6L]

Information warfare policy and ethical issues,information terrorism, threats to information resources including military and economic espionage, communications eavesdropping, computer break-ins, denial-of-service, destruction and modification of data, forgery, control and disruption of information perception management, control measures

Module 7: Cyber Ethics[5L]

Importance of Cyber Law, Significance of Cyber Ethics, Need for Cyber Regulations and Ethics, Ethics in Information Society, Introduction to Artificial Intelligence Ethics, Introduction to Blockchain Ethics.

TEXT BOOKS:

1. CyberEthics: Morality and Law in Cyberspace— Richard A. Spinello, 7thEdition. Jones & Bartlett Publishers, 2020

2. The Ethics of Cybersecurity — Markus Christen , Bert Gordijn, Michele Loi,1st Edition, Springer Open.

REFERENCES:

1. Introduction to cyber security: stay safe online—The Open University,2016.

2. Cryptography and E-Commerce:A Wiley Tech Brief ― Hon C Graff, Wiley Computer Publisher,2001.

Economic Policies in India (UHSS 801)

L-T-P: 3-0-0
Credits: 6

Module 1:
Basic Problems of Indian Economy, Rural Development: Issues Challenges and Government Policy, Urban Development: Issues, Challenges and Government Policy, Issues of Economic Growth and Development, Indicators of Development, Planning Commission and NITI Aayog.

Module 2:
Start –up , Meaning , How to set up , Government policy for promotion of Startup , Present Business and Incubation promotion policy of Government of India Including National Innovation & Startup Policy ,Financial Scheme and Policy for Startup.

Module 3:
Importance and Role of Industries in Economic Development. Growth of Industrial Production in India , Industrial Revolution in India , Problem and Obstacles of Industrial Development in India , Industrial Policy of India , Special Economic Zones : An Overview, Government Subsidies in Industry Sector in India, Act East Policy, Services and trade: trends and performance.

Module 4:
Role of Agriculture in Indian Economy, Features of Indian Agriculture, causes of backwardness of Indian Agriculture and Remedies, Indian Agricultural Policies and performance, production and productivity, Regional Variation. Employment Generation Scheme of Government of India.

Module5:
Information technology and Knowledge economy ,Information technology in India in the global context, Major issues in information technology ,Growth and present status of IT industry in India , Future prospect of IT industry , Globalization and Development , E- Governance System in India and Its Advantage.

References:
1. A. N. Agarawal and M. K. Agarwal – Indian Economy : Problems of Development and Planning , New Age International
2. P. K. Dhar – Indian Economy –Kalyani Publishers
3. Gaurav Datt and Ashwani Mahajan – Indian Economy – S. Chand
4. Ramesh Singh – Indian Economy –Mc Graw Hill
5. NilanjanBanik – Indian Economy – Sage Publisher
6. Misra and Puri –Indian Economy—Kalyani Publishers

3RD YEAR: 6TH SEMESTER (JAN-JUNE)

A. Theory

	Code	Subjects	Contacts (per week)				Credit Points
			L	T	P	Total	
1.	UHSS601	Professional Communication	2	0	0	2	4
2.	UFET601	Food Packaging Technology	3	0	0	3	6
3.	UFET602	Food Analysis, Quality Control and Management	3	0	0	3	6
4.	UFET61*	Elective-I	3	0	0	3	6
5.	UFET61*	Elective-II	3	0	0	3	6
6.	UIE604	Process Control and Instrumentation	3	0	0	3	6
		Total of Theory					**34**

B. Practical

	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	UFET671	Food Packaging Technology Lab	0	0	3	3	3
2.	UFET672	Food Analysis and Quality Control Lab	0	0	2	2	2
3.	UFET681	Product Technology- IV/V Lab	0	0	3	3	3
4.	UIE674	Instrumentation Lab	0	0	2	2	2
		Total of practical					**10**

Total of 6th Semester: 44

4TH YEAR: 7TH SEMESTER (JULY-DEC)

A. Theory

	Code	Subjects	Contacts (per week)				Credit Points
			L	T	P	Total	
1.	UFET701	Food Hygiene and Plant Sanitation	3	0	0	3	6
2.	UFET71*	Elective- I	3	0	0	3	6
3.	UFET71*	Elective- II	3	0	0	3	6
4.	UFET71*	Elective- III	3	0	0	3	6
Total of Theory							**24**

B. Practical

	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	UFET791	Major Project-I	0	0	10	10	10
2.	UFET792	Report and Presentation on Practical Training-II	-	-	-	-	3
3.	UFET770	Seminar	0	0	3	3	3
Total of practical							**16**

Total of 7th Semester: 40

4TH YEAR: 8TH SEMESTER (JAN-JUNE)

A. Theory

	Code	Subjects	Contacts (per week)				Credit Points
			L	T	P	Total	
1.	UFET801	**Plant Design and Project Engineering**	3	0	0	3	6
2.	UFET81*	**Elective-I**	3	0	0	3	6
3.	UFET81*	**Elective-II**	3	0	0	3	6
Total of Theory							18

B. Practical

	Code	Subjects	Contacts (periods per week)				Credit points
			L	T	P	Total	
1.	UFET891	**Major Project-II**	0	0	12	12	12
2.	UFET892	**Project Defense**	-	-	-	-	4
3.	UFET893	**Comprehensive Viva Voce**	-	-	-	-	4
Total of practical							20

Total of 8th Semester: 38

List of Elective Courses in Food Processing Technology

1.   UFET611: Food Product Technology IV- (Bakery, Confectionary and Extruded Products)
2.   UFET612: Food Product Technology V - (Oils and Fats)
3.   UFET613: Genetically Modified Foods
4.   UFET614: Food Toxicology
5.   UFET615: Protein Technology
6.   UFET616: Beverages and Snack Food Technology
7.   UHU711: Marketing and Sales Management
8.   UFET711: Industrial Microbiology and Enzyme Technology
9.   UFET712: Fermentation Technology
10.   UFET713: Refrigeration and Air conditioning
11.   UFET714: Food Product Technology VI- (Fish, Meat and Poultry Technology)
12.   UFET715: New Food Product Development
13.   UFET716: Flavour Technology
14.   UFET717: Food Product Technology VII- (Plantation Crops and Spices)
15.   UFET718: Application of Nanotechnology in Food
16.   UEC718:   Applied Electronics
17.   UFET811: Renewable Energy Technology
18.   UFET812: Modeling and Simulation of Food Processes
19.   UFET813: Concentration and Dehydration of Foods
20.   UFET814: Optimization Techniques in Food Engineering
21.   UFET815: Material Science and Technology
22.   UFET816: Specialty Foods: Nutraceuticals & Functional Foods

DETAILED SYLLABUS

UHSS601: PROFESSIONAL COMMUNICATION

Code: UHSS601
Crdits: 04
L-T-P: 2-0-0

Oral Communication: Aims at improving the oral communication skills. Public speaking skills, features of effective speech – verbal – non-verbal, Presentation skills, Group discussion. Mock Interviews.

Written Communication: Focuses on improving the writing skills. A review of grammar, transformation of sentences; reading comprehension; Precis-writing, skills to express ideas through various kinds of essays; business administrative and E-correspondence, business reports, technical documentation & project proposal writing and CVs/ resumes; Application letters, Notices, Agenda, Minutes & Memos. Case Analysis.

Organization Communication: Attempts to acquaint students with the process and requirements of communication in organizations. It includes the objectives of communication, Channels of communication, Barriers in Communication, Non-verbal & Cross-cultural communication, Meetings, Conferences, Press Conference and Press release. Business Communication Technology: Audio-Visual aids, Internet, e-mail. Creative Communication: Slogan-writing, Advertisement.

Suggested Readings:

1. *Wren & Martin., English Grammar*

2. *John Metchell., How to write Reports*

3. *Mark McCormack., Communication*

4. *Rajendra Pal & J.S. Korlahalli, Essentials of Business Communication*

UFET601: FOOD PACKAGING TECHNOLOGY

Code: UFET601
Credits: 06
L-T-P: 3-0-0

Packaging; Concepts, definition, significance, classification, Functions of packaging; Type of packaging materials; Selection of packaging material for different foods; Selective properties of packaging materials

Primary packaging media; Properties and application, Paper boards, metals, plastics, wood and plywood, glass, flexible materials Labels, caps and closures and adhesives, inks and lacquers, cushioning materials, reinforcements; Testing & evaluation of packages

Active & smart packaging, Vacuum packaging, CAP & MAP, Interactions between packaging material and foods, Printing of packages; Barcodes & other marking

Packaging- Laws and regulations, Environmental consideration in selecting packaging materials, Food marketing and role of packaging, Disposal of packaging materials. Manufacture of packaging materials; Potential of biopolymer-based composite for food packaging

Suggested Readings:
1. Plastics in Packaging by A.S Athlye
2. Food Packaging by Stanley Sacharois & Roger C. Griffin
3. Food Packaging: Principles and Practice by G.L. Robertson
4. Novel Food Packaging Techniques by Raija Ahvenainen
5. Food packaging and Preservation by M. Mathlouthi

UFET602: FOOD ANALYSIS, QUALITY CONTROL AND MANAGEMENT

Code: UFET602
Credits: 06
L-T-P: 3-0-0

Introduction: Concept of quality, quality control and assurance, principles and functions of quality control, quality attributes (qualitative, hidden and sensory), Ways of describing food quality: Composition, appearance, kinesthetic and flavor attributes. Nutritional quality of foods and its assessment (content and quality of nutrients).

Food Analysis: Objective and purposes of food analysis, Food Sampling: Definition of sampling, purpose, sampling techniques requirements and sampling procedures. Food adulteration and simple and quick method of adulteration detection, methods and purpose of estimation of moisture, crude fat proteins, crude fiber and ash. Physico-chemical and mechanical properties: Colour, flavour, consistency, viscosity, texture and their relationship with food quality. Microbial contamination and safety of food.

Sensory quality control: Definition, objectives, panel selection, its evaluation, instrumental measurement of sensory attributes such as color, viscosity, texture etc.

Quality control, method of quality control within and outside the industry. Subjective and objective quality, concept of GAP, GMP, GHP. HACCP its application and benefits.

Quality tolls and its application in quality management. Concept of process control and Statistical process control, application of Statistical quality control (SQC) in quality assurance. TQM and TQC. Failure mode effect analysis. Introduction and application of Sigma Six (6σ) in quality assurance/

Food Regulations: Objectives, requirements and benefits of food grades and standards (BIS, AGMARK, PFA, FPO, FAO, CODEX, WHO, ISO).

Suggested Readings:

1. *Quality control in the food industry -S. M. Herschfoerfer*
2. *Quality control for the food industry -A. Kramer and B.A.Twigg*
3. *Principles of sensory evaluation of Foods -M. A. Amerine*
4. *Rheology and Texture in Food Quality -J. M. deMan, P. W. Vowsy*
5. *Food Chemistry - Fenemma*
6. *Analysis of Fruits and vegetables –Ranganna*

UIE604: PROCESS CONTROL AND INSTRUMENTATION

Code: UIE604
Credits: 06
L-T-P: 3-0-0

Introduction of process variables, static and dynamic characteristic of instruments and their general classification. Elements of measuring system and their function, principles, construction and operation of instruments for the measurements, transmission, control/ indication / recording of process variables like pressure, flow, level, humidity and composition. Principles of transducers: electropneumatic, pneumatic, electrical and multipressure.

Construction and characteristics of final control elements such as proportional, integral, PD, PID controllers, pneumatic control valve, principles and construction of pneumatic and electronic controllers.

Process instrumentation diagrams and symbols, process instrumentation for process equipments such as distillation column, heat exchangers, fluid storage vessel.

Laplace Transform, Linear open loop system, first and second order system and their transient response. Interacting and non interacting system. Transportation lag, linear closed loop system, block diagram of closed loop transfer function, controllers, transient response of closed loop systems.

Stability concept, Routh stability criterion, relative stability, huwitz Stability criterion, Nyquist's criterion. Root locus technique, introduction to frequency response, bode diagrams, bode stability criterion, gain and phase margins, Ziegler Nicholas controller setting.

Suggested Readings:

1. *Coughanowr, D. R. Process Systems Analysis and Control 2nd edition McGraw Hill 1991.*
2. *Stephanopoulos, G , Chemical process control PHI,1984 ,NEW DELHI.*
3. *Luyben, W. L, Process Modeling, Simulation and Control for Chemical Engineers, McGraw hill, 1973.*
4. *Patranabis D., Principles of Industial Instrumentation .*
5. *Eckman D.P., Principles of Industrial instrumentation Willey Eastern,1978.*

UFET671: FOOD PACKAGING TECHNOLOGY LABORATORY

Code: UFET671
Credit:03
L-T-P: 0-0-3

List of Experiments:

S. No.	Experiments	Contact Hours
1.	Identification of different types of packaging and packaging materials	2 Hours
2.	Measurement of thickness and water absorption of packaging films, papers and boards	2 Hours
3.	Determination of tensile/compression strength of given material	2 Hours
4.	To study the sealing strength and bursting strength of flexible packaging material	2 Hours
5.	Determination of WVTR/OTR of various packaging materials	2 Hours
6.	To study the operation of metal can manufacturing process	2 Hours
7.	To study the operation of crown capping process	2 Hours
8.	To study the operation of external threaded capping process	2 Hours
9.	To study the operation of Form-Fill-Seal (FFS) packaging process	2 Hours
10.	To study the operation of modified atmosphere packaging (MAP) process	2 Hours
11.	Destructive and non-destructive test on glass container (drop test)	2 Hours
12.	Evaluation of residue migration from package to food	2 Hours

UFET672: FOOD ANALYSIS AND QUALITY CONTROL LAB

Code: UFET672
Credit: 02
L-T-P: 0-0-2

List of Experiments:

S. No.	Experiments	Contact Hours
1.	To study the sensory evaluation and acceptability of foods, beverages etc. using 9-point hedonic scale	2 Hours
2.	To study the texture of different food sample using texture analyzer with different texture profile	2 Hours
3.	To study the color of various food sample using Hunter Lab Colorimeter	2 Hours
4.	To study the quality of different fruits and vegetable products	2 Hours
5.	To study the quality analysis of spices	2 Hours
6.	To study the quality analysis of milk	2 Hours
7.	To study the quality Analysis of tea and coffee	2 Hours
8.	To study the quality analysis of wheat flour and bread	2 Hours
9.	To study the quality Analysis of non-alcoholic beverages	2 Hours
10.	To study the starch quality during heat processing using Rapid Visco-Analyser	2 Hours
11.	To study the rheological properties and its quality of liquid food sample using Rheometer	2 Hours
12.	To study the detection test of adulteration for various types of food sample	2 Hours

UFET681- PRODUCT TECHNOLOGY- IV/V LAB

Code: UFET681
Credit:03
L-T-P: 0-0-3

List of Experiments:

1.	Determination of sedimentation value of flour.	Contact Hours:2
2.	Falling number test for wheat flour	Contact Hours:2
3.	Determination of alcoholic acidity of flour	Contact Hours:2
4.	Estimation of gluten content of wheat flour	Contact Hours:2
5.	Determination of moisture content of flour	Contact Hours:2
6.	Determination of ash content of flour	Contact Hours:2
7.	Dough- rising capacity test.	Contact Hours:2
8.	Preparation bread and cake	Contact Hours:2
9.	Preparation of biscuit.	Contact Hours:2
10.	Texture analysis of bread, biscuit and cake	Contact Hours:2

UIE674- INSTRUMENTATION LAB

Code: UIE674
Credit:02
L-T-P: 0-0-2

List of Experiments:

S. No.	Experiments	Contact Hours
1.	To Study and Plot the temperature versus Emf curves/characteristics for thermocouple to determine Sensitivity of the Thermocouple	2 Hours
2.	To Study and plot the Temperature versus Resistance Characteristics of thermistor and determine Sensitivity of the Thermistor	2 Hours
3.	To study and plot the temperature versus resistance characteristics of RTD and determine the sensitivity of the RTD	2 Hours
4.	Displacement Measurement using Inductive Transducer (LVDT)	2 Hours
5.	To calibrate the pH Meter using the given standard buffer solution and to measure the pH of the given sample solution using the calibrated pH Meter	2 Hours
6.	Study of Strain measurement using strain gauges and cantilever assembly and to determine Linear Range of operation and sensitivity of Trainer	2 Hours
7.	To reduce the given block diagram and obtain the overall transfer function using MATLAB command	2 Hours
8.	To obtain the Unit step, unit ramp, unit impulse and unit parabolic response of a first order and second order system using MATLAB Command	2 Hours
9.	To find the step response of 2nd order system for different values of zeta and to determine the rise time, peak time, peak overshoot and settling time	2 Hours
10.	To determine Kp, Kv, Ka and ess for the given open loop transfer function of a unity feedback system	2 Hours
11.	Obtain the root locus plot for the given system and comment on the stability	2 Hours
12.	To study the Modelling of the two-rank interacting and non-interacting System using MATLAB Programming /Simulink	2 Hours
13.	To study about different controls in flow loop (PCUSIM Based)	

UFET611: FOOD PRODUCT TECHNOLOGY IV- (BAKERY, CONFECTIONARY AND EXTRUDED PRODUCTS)

Code: UFET611
Credits: 06
L-T-P: 3-0-0

Current status & growth rate of Bakery, Confectionary and Extruded products Industry in India. Microbial safety of products, pertinent standards & regulations.

Bakery Products: Ingredients & processes for breads, biscuits, cookies & crackers, cakes & pastries; doughnuts; rusks; other baked products.

Equipments used, product quality characteristics, faults and corrective measures for above bakery products. Defining and assessing quality of ingredients & products. Safety and hygiene of bakery plants.

Confectionary Products: Types of confectionaries- candies, toffees, chocolates and other confections. Equipments & processing techniques, Characteristic properties of sugar and other sweeteners used in confectionaries, Factors effecting crystallization in confectionary making, faults and corrective measures. Cocoa, Processing of Cocoa into various products, Chocolate Processing: Ingredients, Mixing, Refining, Conching, Tempering, Molding, Cooling, Coating, Enrobing.

Production of chewing and bubble gums. **Extruded Products:** Objectives and importance of extrusion in food product development; Components and functions of an extruder; Classification of extruder; Advantages and disadvantages of different types of extrusion; Change of functional properties of food components during extrusion; Effects in the nutritional quality of foods due to extrusion, Pre and post extrusion treatments; Manufacturing process of extruded products; Application of extrusion technologies in food industries. Breakfast cereals, macaroni products.

Suggested Readings

1. *Bakery Technology and Engineering by Samuel a. Matz, CBS Publications.*
2. *Cereals as Food and Feed by Samuel A.Matz, CBS Publications*
3. *Industrial Chocolate Manufacture by Beckette.*
4. *Dough rheology and baked product texture by Faridi Faubion, CBS Publications.*
5. *Chocolate, Cocoa and Confectionary by Minifie B.W.*
6. *Cookies & Cracker Technology by S.A. Matz.*
7. *Baking Science and Technology by Pyler*
8. *Basic Banking by S.C. Dubey.*
9. *Extrusion of Food, Vol 2; Harper JM; 1981, CRC Press.*
10. *Up to-date Bread Making; Fance WJ & Wrogg BH; 1968, Maclasen & Sons Ltd.*
11. *Modern Cereal Chemistry; Kent-Jones DW & Amos AJ; 1967, Food Trade Press Ltd.*

UFET612: FOOD PRODUCT TECHNOLOGY V - (OILS AND FATS)

Code: UFET612
Credits: 06
L-T-P: 3-0-0

Sources; chemical composition; physical and chemical characteristics; functional and nutritional importance of dietary oils and fats.

Extraction of oil by rendering, supercritical fluid extraction, enzyme-derived oil extraction, mechanical expelling and solvent extraction Processing of other plant sources of edible oils and fats like coconut, cottonseed, rice bran, maze germ, etc.

Refining of oil- Clarification, degumming, neutralization (alkali refining), bleaching, deodorization techniques / processes, pyrolysis of fats, toxicity of frying oil, Processing of refined oils-Hydrogenation, fractionation, winterization, inter-esterification etc.

Production of butter oil, lard, tallow, Margarine, Cocoa butter equivalents, shortenings, low fat spreads, peanut butter etc. Oil seed protein isolates and other by-products of fat/oil processing industries

Suggested Readings

1. Bailey's Industrial Oil & Fat Products, 4th ed.John Wiley & Sons.
2. The Industrial Chemistry of Fats & Waxes 3rd. by Balliere,Tindall & Cox.
3. Handling & Storage of Oiseeds,Oils,Fats & Meal by Paterson, HBW.
4. Modern Technology in the Oils & Fats industry by S.C. Singhal,OTA (I).
5.The Chemistry & Technology of Edible Oils and Fats; Devine J & Williams PN;
1961, Pergamon Press.
6. Food Oils and their Uses; Weiss TJ; 1983, AVI.
7. Edible Oils & Fats: Developments since 1978 (Food Technology Review # 57);
Torrey S; 1983, NDC.

UFET613: GENETICALLY MODIFIED FOODS

Code: UFET613
Credits: 06
L-T-P: 3-0-0

Introduction to GM foods – Advantages of GM foods – Herbicide tolerant crops – Frost resistance – Drought and salinity resistance – Insect resistance – Virus resistance – Nutritional fortification Methods of establishing Genetically Modified Plants – Transformation methods –*Agrobacterium* transformation and Direct gene transfer

Transgenic plants - Commercially available GM crops – *Bacillus thuringiensis* corn (StarLink corn) – Golden Rice – Fungal resistant Bintje potatoes – Lectin potato - Methionine enriched oil – Calgene FLAVR SAVR tomato - Chymosin Bovine Somatotrophin Lite Beer L-tryptophan – Indian Bt eggplant

Creation of Transgenic animals – Gene transfer in poultry – Gene transfer in fish – Transgenes –gene constructs - Improved growth rate, carcass composition and feed efficiency – Transgenic mammalian farm animals - Transgenic fish -Atlantic Salmon - Bovine Somatotropin un-Milk – *alpha* lactalbumin and lactoferrin in milk - Growth hormone genes in pigs -

Genetically engineered bacteria – Genetically modified Saccharomyces strains – applications in Beer, wine, sake and bread Beta-carotene in rice - Transgenic "heart-healthy" Canola oil edible vaccines – Hepatitis B vaccine in maize – Cholera vaccine in potatoes.

Risk associated with GM foods – Allergens, toxins, antibiotic resistance, soil contamination - Creation of superbugs and superweeds - Increased risk of immune-suppression and cancer risks – Labeling GM foods – Ethics related to cloning – Biosafety and risk assessment

Suggested Readings

1. *Knutt J.Heller, "Genetically engineered food – Method and detection" Wiley – VCH, 2nd edition, 2006.*
2. *Colin Andre Carter et al., "Genetically modified food and Global welfare" Frontiers of Economics and Globalization, Emerald Group Publishing Limited, 1st edition, 2011.*
3. *Stephen Nottingham "Eat your genes: How genetically modified food is entering your diet"Zed Books Ltd, 2nd edition, 2003.*
4. *Kung, Shain-Dow "Biotechnology and Food Quality" – Butterworth, 1989.*
5. *Jerry Freedman, "Genetically modiefied food – How Biotechnology is changing what we eat" – The Rosen Publishing Group, Inc. , 1st edition, 2009.*

UFET614: FOOD TOXICOLOGY

Code: UFET614
Credits: 06
L-T-P: 3-0-0

Definition scope and general principles of food toxicology; manifestation of toxic effects; classification of food toxicants; factors affecting toxicity of compounds; methods used in safety evaluation-risk assessments.

Toxicants and allergens in foods derived from plants, animals, marine, algae & mushroom;

Derived Food toxicants- Processing & Packaging; Toxicants generated during food processing such as nitrosamines, acrylamide, benzene, dioxins and furans; persistent organic pollutants.

Toxicology & food additives; Intentional direct additives, preservatives, nitrate, nitrite, and N- nitroso compound flavor enhancers, food colours, indirect additives, residues and contaminants, heavy metals, other organic residues and packaging materials. Toxicity of heated and processed foods, food carcinogens and mutagens - Polycyclic aromatic hydrocarbons, N - nitrosamines, Acrylamide and their mode of action

Quantitative and qualitative analysis of toxicants in foods; Biological determination of toxicants
Assessment of food safety – Risk assessment and risk benefit indices of human exposure, acute toxicity, mutagen city and carcinogenicity, reproductive and developmental toxicity, neurotoxicity and behavioral effect, immunotoxicity.

Suggested Readings
1. Helferich, William and Carl K.Winter "Food Toxicology", CRC Press, 2001.
2. Alluwalia, Vikas "Food Hygiene and Toxicology" Paragon International Publishers, 2007
3. Shibamoto, Taka yuki and Leonard F.Bjeldanzes "Introduction to Food Toxicology" II Edition. Academic Press, 2009.
4. Maleki, Soheila J. A.Wesley Burks, and RickiM.Helm "Food Allergy" ASM Press, 2006.
5. Labbe, Ronald G. and Santos Garcia "Guide to Food Borne Pathogens" John Wiley & Sons, 2001.
6. Cliver, Dean O. and Hans P.Riemann "Food Borne Diseases" II Edition., Academic Press/Elsevier, 2002.
7. Riemann, Hans P. and Dean O. Cliver "Food Borne Infections and Intoxications" III Edition, Academic Press/Elsevier, 2006.
8. Branen AL, Davidson PM & Salminon S. 1990. Food Additives. Marcel Dekker.
9. Concon JM.1988. Food Toxicology - Principles & Concepts. Marcel Dekker.
10. Hathcock JN. (Ed.). 1982. Nutritional Toxicology. Vol. I. Academic Press.
11. Rechcigl M Jr. 1983. (Ed.). Handbook of Naturally Occurring Food Toxicants. CRC Press.
12. Shabbir S. 2007. Food Borne Diseases. Humana Press.
13. Steven T. 1989. Food Toxicology: A Perspective on Relative Risks
14. Tweedy BG.1991. Pesticide Residues and Food Safety. Royal Society of Chemistry.

UFET615: PROTEIN TECHNOLOGY

Code: UFET615
Credits: 06
L-T-P: 3-0-0

Protein structure and chemistry: Primary, Secondary, Tertiary and Quaternary structure of protein; Simple and Globular Proteins, Protein-Protein interactions, methods of evaluation of protein quality and amount, Conventional and novel sources of protein. Nutritional and commercial importance of proteins. Commercial sources of proteins.

Protein Engineering- Advantages and purpose, overview of methods, underlying principles with specific examples: thermal stability T4-lysozyme, recombinant insulin to reduce aggregation and inactivation, de novo protein design.

Protein concentrates and isolates- introduction, process of making protein isolates and concentrates, factors affecting quality of isolates and concentrates.

Proteins from plants – Composition and functional properties of soya, rapeseed, peanut. Food applications.

Proteins from animal sources – Composition, structural and functional properties Animal proteins - Caseins and Whey proteins - caseins micelles – Muscle proteins – Sea weed proteins – Application in Food systems.

Suggested Readings

1. Voet D. and Voet G., "Biochemistry", Third Edn. John Wiley and Sons, 2001
2. Branden C. and Tooze J., "Introduction to Protein Structured, Second Edition",
Garland Publishing, NY, USA, 1999
3. P. F. Fox, J. J. Condon. Food Proteins, Kluwer Science, 1982.
4. B. J. F. Hudson. New and Developing Sources of Food Proteins, Chapman and Hall, 1994.
5. Zidzisław E. Sikorski, Chemical and Functional Properties of Food Proteins, CRC Press, 2001.
6. Creighton T.E. Proteins, Freeman WH, Second Edition, 1993
7. Moody P.C.E. and Wilkinson A.J. "Protein Engineering", IRL Press, Oxford, UK, 1999
8. Altschul, A.M. and Wilcke, H.L. Ed. 1978. New Protein Foods. Vol. III. Academic Press, New York.
9. Bodwell, C.E. Ed. 1977. Evaluation of Proteins for Humans. AVI, Westport.
10. Milner, M., Scrimshaw, N.S. and Wang, D.I.C. Ed. 1978. Protein Resources and Technology. AVI, Westport.
11. Salunkhe, O.K. and Kadam, S.S. Eds. 1999. Handbook of World Legumes: Nutritional Chemistry, Processing Technology and.Utilization. Volume I to III. CRC Press, Florida.
12. Salunkhe, D.K. Chavan, J.K., Adsule, R.N. Kadam, S.S. 1992. World Oilseeds:Chemistry, Technology and Utilization, Van Nostrand Reinhold, New York.

UFET616: BEVERAGE AND SNCAK FOOD TECHNOLOGY

Code: UFET616
Credits: 06
L-T-P: 3-0-0

Types of beverages and their importance; status of beverage industry in India; Beverage-definition-ingredients- water, carbon dioxide, bulk and intense sweeteners, water miscible and water dispersible flavouring agents, colours – natural and artificial, Micro and nanoemulsions of flavors and colors in beverages, preservatives, emulsifiers and stabilizers.

Technology for carbonated beverages – Processes technology - carbonation equipments-ingredients-preparation of syrups-Filling system-packaging.

Technology for alcoholic beverages- types, manufacture and quality evaluation; the role of yeast in beer and other alcoholic beverages, ale type beer, lager type beer, technology of brewing process, equipments used for brewing and distillation, wine and related beverages, distilled spirits.

Technology for grain-based snacks: whole grains – roasted, toasted, puffed, popped and flakes, coated grains salted, spiced and sweetened; flour based – batter and dough-based products; savoury and farsans; formulated chips and wafers, papads, instant premixes of traditional Indian snack foods.

Technology for fruit and vegetable-based snacks: Chips, wafers; Technology for coated nuts – salted, spiced and sweetened; chikkis. Extruded snack foods: Formulation and processing technology, colouring, flavouring and packaging. Equipments for frying, drying, toasting, roasting and flaking, popping, blending, Coating, chipping.

Suggested Readings

1. Hardwick WA. 1995. Handbook of Brewing. Marcel Dekker.
2. Hui YH. et al 2004. Handbook of Food and Beverage Fermentation Technology. Marcel Dekker.
3. Priest FG & Stewart GG. 2006. Handbook of Brewing. 2nd Ed. CRC.
4. Richard P Vine. 1981. Commercial Wine Making - Processing and Controls. AVI Publ.
5. Varnam AH & Sutherland JP. 1994. Beverages: Technology, Chemistry and Microbiology. Chapman & Hall.
6. Woodroof JG & Phillips GF.1974. Beverages: Carbonated and Non Carbonated. AVI Publ.
7. Edmund WL. Snack Foods Processing. AVI Publ.
8. Frame ND .1994.The Technology of Extrusion Cooking. Blackie Academic.
9. Gordon BR.1997 Snack Food.AVI Publ
10. Samuel AM.1976. Snack Food Technology. AVI Publ.

CENTRAL INSTITUTE OF TECHNOLOGY KOKRAJHAR

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UFET701: FOOD HYGIENE AND PLANT SANITATION

Code: UFET701
Credits: 6
L-T-P: 3-0-0

General principle of food hygiene, Hygiene in rural and urban areas in relation to food preparation, personal hygiene and food handling habits. Place of sanitation in food plants. Sanitary aspects of building and equipment: Plant layout and design, Comparative studies on sanitary fabrication of different types of processing equipment.

Safe and effective insect and pest control: Extraneous materials in foods, Principles of Insects and pets control. Physical and chemical control. Effective control of micro-organisms: microorganisms important in food sanitation, micro-organisms as indicator of sanitary quality. Physical and chemical methods.

Sanitary aspects of water supply: Source of water, quality of water, water supply and its uses in food industries. Purification and disinfection of water preventing contamination of potable water supply.

Effective detergency and cleaning practices: Importance of cleaning technology, physical and chemical factors in cleaning, classification and formulation of detergents and sanitizers, cleaning practices.

Sanitary aspects of waste disposal. Establishing and maintaining sanitary practices in food plants, role of sanitation, general sanitary consideration and sanitary evaluation of food plants.

Suggested Readings:

1. Guide to Improve Food Hygiene - Gaston and Tiffney
2. Practical Food Microbiology & Technology - Harry H. Weiser, Mountney, J. and
Gord, W.W.
3. Food Poisoning and Food Hygiene - Betty C. Hobbs
4. Principles of Food Sanitation - Marriott and Norman, G.
5. Hygiene and Sanitation in Food Industry - S. Roday
6. Basic Concepts of Industrial Hygiene, Ronald M Scott, CRC Press.
7. Safety design criteria for industrial plants. Maurizio Cumo & Antonio Naviglia.
CRC Press.
8. Industrial Hygiene & Toxicology by Josef Brozek-1948.
9. Food Hygiene, Microbiology & HACCP. S J Forsythe, P R Hayes. Springer.

UFET711: INDUSTRIAL MICROBIOLOGY & ENZYME TECHNOLOGY

Code: UFET711
Credits: 06
L-T-P: 3-0-0

Introduction: Classification of Microbial products. Microbial Production of organic acids (vinegar, lactic acid, citric acid, gluconic acid and itaconic acid), antibiotics (penicillin, streptomycin), semisynthetic penicillin, enzymes (Amylase, cellulase and pectinase), polysaccharides (Glucan, mannan, gellan, and pullulan), lipids (biosurfactant),

Microbial Production of alcoholic beverages (beer, wine, and distilled alcoholic beverages such as whiskey, rum, vodka), Microbial production of vitamins (B2 and B12), Baker's yeasts; production, Fermenter design

Introduction to enzyme technology; Industrial enzymes – present status and opportunities with special reference to food industries, Intracellular and extra-cellular enzymes, Enzyme production technology, Enzyme purification methods, protein engineering.

Enzyme immobilization, Carrier materials, Immobilization methods, Application of immobilized enzymes in industry, analytical purpose and medical therapy

Suggested Readings

1. Industrial microbiology:-Casida Newage Publication 2001
2. Industrial microbiology:-Prescott and Dunn CBS Publications 4th Ed. 1999
3. Enzymes:-Trevor. Horwood 2001
4. Methods of Enzymology: Rhem and Reid
5 Biochemical Engg Fundamentals-Baily, Ollis. MGH

UFET712: FERMENTATION TECHNOLOGY

Code: UFET712
Credits: 06
L-T-P: 3-0-0

Fermentation Pathways for Industrial Products: Biochemical pathways of metabolic reactions for utilization of carbon sources and formation of different metabolites by micro-organisms; Possibility of control of the reactions for the increased formation of useful metabolites. Strain 24, Development - Various techniques of modifying the strains for increased production of industrial products. Use of chemicals, UV rays, genetic engineering to produce newer strains.

Media for Fermentation: Importance of media components for production of industrial products by fermentation; use of different sources of carbon, nitrogen, minerals and activators for commercial fermentation; importance of pH, temperature and aeration in fermentation; optimization of fermentation media.

Different Types of Fermenters: Laboratory and plant fermenters; shake flasks and advantages; laboratory fermentation systems with various controls and sampling and data collection provisions; aeration and agitation; production fermenters; sterilization of media; cooling systems; inoculation, temperature and pH control systems; scale-up of fermentation process.

Downstream Processing: Various equipment for product recovery; micro-filters and Ultrafiltration systems for separation of cells and fermentation medium and for concentration of medium containing product; chromatographic systems of separation; extraction of product with solvent; evaporation and crystallization; centrifugation, different types of centrifuges; drying techniques; instrumentation and controls.

Fermentative Production: a) Foods: Processes for preparing fermented products including Yogurt (curd) and other Traditional Indian Products like idli, dosa, dhokla, shrikhand, etc., Soya based products like soya sauce, natto, etc., Cocoa, Cheese etc.; control of quality in such products. Alcoholic Beverages based on fruit juices (wines), cereals (whisky, beer, vodka etc,), sugar cane (rum) etc. Process description, quality of raw materials, fermentation process controls etc. b) Industrial chemicals: Fermentative Production of Organic acids like (Citric Acid, Lactic Acid), Amino Acids (Glutamic acid, Lysine), Antibiotics (Erythromycin, Penicillin), Polysaccharides (Dextran, Xanthan) etc.; steroids transformation and industrial enzyme production by micro-organisms; process descriptions and key controls for optimal production.

Suggested Readings

1. Vogel, H.C. and C.L. Todaro, 2005 Fermentation and Biochemical Engineering Handbook : Principles, Process Design and Equipment , 2nd Edition, Standard Publishers.
2. El-Mansi, E.M.T, 2007, Fermentation Microbiology and Biotechnology 2nd Edition, CRC / Taylor & Francis.
3. Joshi, V.K. and Ashok Pandey, 1999, Biotechnology: Food Fermentation, Microbiology, Biochemistry and Technology , Vol. I & vol. II Educational Publisher.

UFET713: REFRIGERATION AND AIRCONDITIONING

Code: UFET713
Credits: 06
L-T-P: 3-0-0

Introduction: Review of basic laws of thermodynamics; Method for production of cold; Reversed Carnot cycle; Carnot; Refrigeration and heat pumps.

Mechanical Vapour Compression Refrigeration: Simple vapour compression cycle; Comparison with reversed cannot cycle; Standard rating cycle and effect of operating conditions; Evaporator pressure; Condenser pressure; Suction vapour superheat and liquid subcooling on cycle performance; Actual cycle.

Properties of Refrigerants: Designation of refrigerants; characteristics; Thermodynamic physical and chemical requirements. Multistage and Multievaporator Systems Cascade systems; Ice manufacture.

Compressors: Type of compression processes: Volumetric efficiency; Principle dimensions; Performance characteristics and performance of reciprocating compressors. **Expansion Valves**: Construction and working of automatic and thermostatic expansion valves. **Evaporators**: Flooded and dry evaporators; Mechanism of cool boiling in evaporators; Flow boiling in evaporators. **Condensers:** Air cooled and water-cooled condensers; Evaporative condensers.

Vapour Absorption System of Refrigeration: Simple vapour absorption system; Physical, chemical and thermodynamic requirements of refrigerant absorbent mixtures; Modifications in simple vapour absorption system.

Air Conditioning: Psychometry; Psychometric properties of moist air; Adiabatic psychrometer chart. **Psychometric Processes:** Psychometry of air conditioning processes; Air washers; Winter air conditioning; Simple air conditioning system; State and mass rate of supply air. **Design Conditions:** Inside and outside design conditions; Comfort chart and effective temperature and respiration heat. **Cooling Load Calculations:** Internal and system heat gains; Ventilation load; Cooling load estimate; Design of cold storages. **Transmission and Distribution of Air:** Room air distribution; Total static and velocity pressure; Friction and dynamic losses in ducts.

Suggested Readings

1. Arora, C.P. "Refrigeration and Air Conditioning". Tata Me Graw Hills, 1981.
2. Prasad, Manohar. "Refrigeration and Air Conditioning". Wiley Eastern, 1983.
3. Dossat, RJ. "Principles of Refrigeration". Wiley Eastern, 1981.
4. Stoecker, W.F. "Refrigeration and Air Conditioning". Me Graw Hill.

UFET714: FOOD PRODUCT TECHNOLOGY VI - (FISH, MEAT AND POULTRY TECHNOLOGY)

Code: UFET714
Credits: 06
L-T-P: 3-0-0

Classification of fresh water fish and marine fish; Commercial handling, storage and transport of raw fish; Average composition of fish; Freshness criteria and quality assessment of fish; Spoilage of Fish; Methods of Preservation of fish: Canning, Freezing, Drying, Salting, Smoking and Curing.

Fish products and by products- Production of fish sauce, fish paste, fish sausage and fish meal, fish protein concentrate, fish liver oil, fish soluble, fish glue, gelatin and isinglass, fish silage, chitosan.

Slaughtering technique of animal; Meat cuts and portions of meat, muscle; Color of meat; Post mortem changes of meat; Meat processing - curing and smoking; Fermented meat products (meat sausages & sauces); Frozen meat & meat storage; By-products from meat industries and their utilization;

Classification of poultry meat; Composition and nutritional value of poultry meat & eggs; Processing of poultry meat and eggs; Spoilage and control; Byproduct utilization and future prospects;

Suggested Readings

1. Processed Meats; Pearson AM & Gillett TA; 1996, CBS Publishers.
2. Meat; Cole DJA & Lawrie RA; 1975, AVI Pub.
3. Egg and poultry meat processing; Stadelman WJ, Olson VM, Shemwell GA & Pasch S; 1988, Elliswood Ltd.
4. Developments in Meat Science – I & II, Lawrie R; Applied Science Pub. Ltd.
5. Egg Science & Technology; Stadelman WJ & Cotterill OJ; 1973, AVI Pub.
6. Fish as Food; Vol 1 & 2; Bremner HA; 2002, CRC Press.
7. Fish & Fisheries of India; Jhingram VG; 1983, Hindustan Pub Corp.
8. Fish as Food, Vol. I-IV; George Borgstrom, Academic Press
9. Fish Processing Technology, Rogestein & Rogestein

UFET715: NEW FOOD PRODUCT DEVELOPMENT

Code: UFET715
Credits: 06
L-T-P: 3-0-0

Market survey and its importance in; designing a questionnaire to find consumer needs for a product or a concept; advantages of processed foods in urbanized Modern Society; Developing a Product to Meet the Requirements. New Food Product Development (NPD) process and activities, NPD success factors, food innovation case studies, market-oriented NPD methodologies, organization for successful NPD; Recipe Development; use of traditional recipe and modification; 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.

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.

Product Stability; evaluation of shelf-life; changes in sensory attributes and effects of environmental conditions; accelerated shelf-life determination; Regulatory Aspects; whether standard product and conformation to standards; Approval for Proprietary Product.

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- 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. Brody, A. L. and John B. L. "Developing New Food Products for a Changing Marketplace", 2nd Edition, CRC / Taylor & Francis, 2008
2. Fuller, G.W. "New Food Product Development: From Concept to Marketplace", CRC, 2004.
3. Macfie, H. "Consumer-led Food Product Development", CRC/Wood Head, 2007
4. Side, C. "Food Product Development: Based on Experience", Iowa State Press/Blackwell, 2002.
5. Gupta, R. "Food Retailing: Emerging Trends", ICFAI University, Press, 2005
6. Chakraborty, A. "Food Processing: Opportunities and Challenges", ICFAI University Press, 2006.

UFET716: FLAVOUR TECHNOLOGY

Code: UFET716
Credits: 06
L-T-P: 3-0-0

Olfactory perception of flavour and taste – Theories of olfaction - Molecular structure and activity relationships of taste – Sweet, bitter, acid and salt, Chemicals causing pungency, astringency, cooling effect – properties.

Classification – Alliaceous flavours – Bittering agents, Coffee and Cocoa, Fruit flavours. Evolution of flavours during processing – enzymatic development, effect of roasting, cooking, frying on flavour developments

Anatomy of the chemical senses; neural development of the chemical senses; receptor mechanisms, neural coding; the control of eating.

Subjective versus Objective methods of analysis; psychophysics and sensory evaluation and its types, E-Nose, E- Tongue; Instrumental analysis; sample handling and artifacts; data handling

Problem based learning; tongue and nose; Onion-Beverage-Maillard reaction-Thio-stench

Suggested Readings
1. Fisher, Carolyn and Thomas R. Scott. "Food Flavours: Biology and Chemistry". The Royal Society of Chemistry, 1997.
2. Heath, H.B. and G. Reineccius. "Flavor Chemistry and Technology". CBS Publishers, 1996.
3. Reineccius, Gary. "Flavor Chemistry and Technology". II Edition, Taylor & Francis, 2006.
4. Shahidi, Fereidoon and Chi-Tang Ho. "Flavor Chemistry of Ethnic Foods". Kluwer Academic / Plenum, 1999.
5. Ashurst, Philip R. "Food Flavorings". III Edition, Aspen Publications, 1999.
6.. Hofmann, Thomas. "Challenges in Taste Chemistry and Biology". American Chemical Society Publications, 2004.
7. Charalambous, G. "Food Flavors: Generation, Analysis and Process Influence". Elsevier, 1995.

UFET717: FOOD PRODUCT TECHNOLOGY VII- (PLANTATION CROPS AND SPICES)

Code: UFET717

Credits: 06

L-T-P: 3-0-0

Tea: Occurrence, chemistry of constituents; harvesting; types of tea – green, oolong and CTC; chemistry and technology of CTC tea; manufacturing process for green tea and black tea manufacture; instant tea manufacture; quality evaluation and grading of tea.

Coffee: Processing of coffee, type of coffee, drying, fermentation, roasting and browning processes and their importance. process flow sheet for the manufacture of coffee powder; instant coffee technology; chicory chemistry; quality grading of coffee.

Cocoa: Occurrence, chemistry of the cocoa bean; changes taking place during fermentation of cocoa bean; processing of cocoa bean; cocoa powder; cocoa liquor manufacture; chocolates–types, chemistry and technology of chocolate manufacture; quality control of chocolates.

Scope of spice processing in India, Types, spice qualities and specification, uses and physiological effects, components, antimicrobial and antioxidant properties, Medicinal value of condiments and spice products.

Processing and manufacturing of major Indian Spices: Pepper, cinnamon, cardamom, Nutmeg, saffron, turmeric and Ginger, minor spices- cloves, leafy spices, bay oregano, and seed spices. Spice processing machineries, packaging and handling of spices. Spice blends and extractives, essential and encapsulated oils, oleoresins – uses in processed foods

Suggested Readings*:*

1. Banerjee B. 2002. *Tea Production and Processing. Oxford Univ. Press.*
2. *Minifie BW. 1999. Chocolate, Cocoa and Confectionery Technology. 3rd Ed. Aspen Publ. NIIR. 2004. Handbook on Spices.*
3. *National Institute of Industrial Research Board, Asia Pacific Business Press Inc.*
4. *Sivetz M & Foote HE. 1963. Coffee Processing Technology. AVI Publ*
5. *Hirasa, K and Takemasa, M. "Spice Science and Technology", Marcel Dekker, 1998.*
6. *Pruthi, S. "Quality Assurance in Spices and Spice Products (Modern methods of analysis)", Allied Publishers, 1999*

UFET718: APPLICATION OF NANOTECHNOLOGY IN FOOD

Code: UFET718
Credits: 06
L-T-P: 3-0-0

Introduction to Nano Technology-Implications for Physics, Chemistry, Biology and Engineering-Classifications of nano materials-Mechanical, Electronic, Optical, Magnetic & Thermal properties-Nanomaterials for food applications- Naturally occurring food nano substances and nanostructure-Designing food nanostructures.

Preparation of Nanomaterials - Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

Introduction to Sensors- Biosensors-Enzyme biosensors and diagnostics-DNA-based biosensors and diagnostics-RFID Integrated nanosensor networks, detection and response- Nanosensors for food quality- Transduction Principles-Examples of biosensors with nanoparticles-Future prospective- Supra molecular structures-Self Assembly-Plant Cells-Organized self-assembled structures.

Application of Nanotechnology in Food Packaging- Properties of nanao materials used in food packaging -Antimicrobial functionality-Visual indicators-Improvement of mechanical properties through nanocomposites-Improvement of the barrier properties, nanocomposites, nano-structured coatings-Improvement of the performance of bio-based polymers-Surface biocides.

Active packaging materials-Intelligent packaging concepts-Potential migration of nano-particles from food contact materials.

**Suggested Readings*:*
1. Qasim Chaudhry, Lawrence Castle and Richard Watkins, "Nanotechnologies in Food" published by Royal Society of Chemistry, ISBN: 9780854041695, ISSN: 17577136, 2010.
2. Lynn J. Frewer, Willem, Norde, Arnout Fischer, and Frans Kampers, "Nanotechnology in Agri-Food Sector" Published by Wiley-VCH Verlag GmbH & co. KGaA Hoschstr. ISBN: 978-3-527-33060-7, 2011.
3. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
4. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition,Weinheim Cambridge, Wiley-VCH, 2000.
5. G Timp, "Nanotechnology", AIP press/Springer, 1999.
6. Akhlesh Lakhtakia,"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

UEC718: APPLIED ELECTRONICS

Code: UEC718
Credits: 06
L-T-P: 3-0-0

Transistor-Transistor as an amplifier: low frequency, single stage and multistage amplifier **Regulated Power Supply:** Capacitors filters for single phase rectifiers. Application of 3-pinvoltage regulators ICs 78**/79**317/337

OPAMP: Introduction to operational amplifiers. Applications of OPAMP:1) Summing scaling, Averaging, integrator and differentiator:2) OPAMP as comparator 3) Instrumentation Amplifier and its application.

Digital Electronics :(1) combinational circuits: multiplexers, demultiplexers, decoders, encoders, (2) flipflops: S-R F/F, clocked S-R, F/F, DF/F, J-KF/F, TF/F (3) Counters: Asynchronous (Ripple) counter, Asynchronous UP/DOWN counter, Synchronous counter, Synchronous UP/DOWN counter (4) Registers: Serial-in, Serial-out; Parallel-in, serial-out; Serial-in, parallel out; Serial/parallel in, Serial/Parallel out.

D/A converters: R/2R register ladder. D/A converter. A/D converters: successive approx. A/D converter.

Microprocessor: Concept of microprocessor, software architecture of 8086, Addressing modes, Data transfer arithmetic logical, Jump/Call, String instructions, Writing simple assembly language programmes, technical details o serial and parallel ports of IBM compatible PC.

Suggested Readings

1. Millman, Halkias,"Basic Electronics", Tata McGraw-Hill.
2. Coughlin and Driscoll, "Operational Amplifiers and Linear integrated Circuits",
Prentice Hall of India.
3. Bray B.B, "8086-486 Intel Microprocessor", Prentice Hall of India.
4. Hall, D., "8086 Microprocessor", Tata McGraw Hill.

UHU711 MARKETING AND SALES MANAGEMENT

Code: UHU711
Credits: 06
L-T-P: 3-0-0

Marketing Concept-Defining Marketing, Core Marketing Concept: Production Concept, Product Concept, Selling concept and Marketing Mix Concept.

Analyzing Consumer Markets & Buyer Behaviour, Major factors influencing buyer behavior: Cultural factors, personal factors, social factors and psychological factors. Concept of Family Life Cycle.

Product policy-product and service differentiation, Product concept, product levels, product classification, new product Development process, product life cycle, Product Mix Decision, Branding. Concept of price wars.

Promotion policy-Need for promotion, promotion techniques. Channel and Distribution Policy-Channel Structure, Channel decision, Wholesaling, Retailing, Physical Distribution decisions. Tranport modes available in India with its merits and demerits.

Sales Management, selling function-personnel selling-Locating prospects, building prospect list, Pre-call planning, Sales approach-customer Needs Analysis-Sales Presentation-Handling Customer objections.
Territory Management. Sales ethics. Sales forecasting. Recruitment Training Sales people, Compensation for sales people, Evaluating Sales force performance.

Suggested Readings

1. *Philip Kotler—Marketing Management*
2. *Vaswas Das Gupta—Sales Management*
3. *Fredrick Russel—Selling:Principles & Practices*

UFET801: PLANT DESIGN AND PROJECT ENGINEERING

Code: UFET801
Credits: 06
L-T-P: 3-0-0

Process Design and Development: Introduction to plant design and General design considerations; Stages involved in the plant design development. Screening of the project idea, need analysis, comparative rating of product ideas; Pre-feasibility and detail feasibility analysis.

Design consideration for plant location and guidelines for choosing plant location. Introduction to plant layout and design, types of flow patterns in layout and types of plant layout.

Introduction to project engineering, materials of construction, material handling equipment, process utilities. Process diagrams and symbols used for food plant design.

Process Economics: Life cycle of product; Economics feasibility of project using order of magnitude cost estimates plant and equipment cost estimations, product cost estimations, break even analysis.

Engineering terms: Cash flows, Time value of money, interest, taxes, depreciation, book value, salvage value, replacement.

Profitability Analysis: Rate of return, payback period, discount rate of return, net present worth, internal rate of return, comparing investment alternatives.

Suggested Readings:

1. Douglas ,J.M. , "Conceptual Designs of Chemical Processes", McGraw Hill, 1989.
2. Peters ,M.s and Timmerhaus ,K.D, "Plant Designs and Economics for Chemical Engineers'' 4th Edition McGraw Hill, 1991
3. Biegler L.,grossmann I.E.and Westeberg A.W. "Systematic Methods of Chemical Engineering and Process Designs ," prentice Hall ,1997.
4. Rao, D.G, "Fundamentals of Food Engineering", PHI Learning Private Limited,2014.

UFET811: RENEWABLE ENERGY TECHNOLOGY

Code: UFET811
Credits: 06
L-T-P: 3-0-0

Biological fuel generation; Biomass as a renewable energy source; Types of biomasses: forest, agricultural and animal residues; Industrial and domestic organic wastes; Conversion of biomass to clean fuels and petrochemical substitutes by physicochemical and/or fermentation processes.

Biogas from anaerobic digestion; Thermal energy from biomass combustion; Ethanol from biomass.

Hydrogen production by photosynthetic bacteria, bio-photolysis of water and by fermentation; Microbial recovery of petroleum by biopolymers (Xanthum gum), biosurfactants.

Solar energy; Solar collectors, solar pond, photovoltaic cells, chemical storage; Geothermal energy and wind energy; Use of geothermal energy; Operating principles of different types of wind energy mills; Nuclear energy; Nuclear reactions and power generation; Tidal wave energy.

Suggested Readings

1. J.E.Smith – Biotechnology, 3rd edn. Cambridge Univ Press.
2. S.Sarkar – Fuels and combustion, 2nd edn., University Press.

UFET812: MODELING AND SIMULATION OF FOOD PROCESSES

Code: UFET812
Credits: 06
L-T-P: 3-0-0

Introduction to mathematical modeling; Process analysis and simulation; Model building; Classification and uses of mathematical models; Formulation of mathematical model and fundamental laws.

Batch processes in food industry; Equilibration in batch processes; Steady state flow processes of non reacting systems; Mixing in flow processes.

Simultaneous heat and mass transfer in packed tower and immobilized enzyme system.

Modelling, simulation and optimization of fermentation processes.

Suggested Readings

1. Process modeling, simulation and control: William L Luyben, TMH
2. Process analysis & simulation: Himmelblau, Kenneth & Birchoff, John Wills.

UFET813: CONCENTRATION AND DEHYDRATION OF FOODS

Code: UFET813
Credits: 06
L-T-P: 3-0-0

Introduction: Importance of concentration and dehydration; Various methods; Concept of water activity and sorption isotherms; Fundamentals of air-water vapour mixtures; Physico-chemical Changes caused by concentration and dehydration.

Evaporation: Properties of liquid for selection; Heat and mass balance on single and multiple effect evaporators; Types of evaporators.

Freeze Concentration: Applications, Advantages and disadvantages; Principles involved; Types of freeze concentrators.

Membrane Concentration Process: Fundamentals of membrane processing; Application of UF and RO Membranes; Properties of membranes; Types of UF and RO modules; Permeate flow calculations.

Drying of Liquid Foods: Methods of drying; Spray Drying: Stages involved, types of atomizers, types of spray dryers; powder removal methods, drying time calculation, two stage drying, factors affecting powder properties, instantiation; Drum Drying: Types of drum dryers, methods of feeding liquid, design of drum dryer.

Drying of solid foods: Drying process - constant rate period, falling rate period; mechanisms of moisture transfer; drying time calculations; factors affecting drying time; types of dryers.

Freeze Drying: Fundamentals of freeze drying; Freezing; Primary and secondary drying; Freeze-drying calculations; Types of freeze dryers.

Suggested Readings

1. Billet, Reinhard, "Evaporation Technology: Principles, Applications and Economics" VCH Publishers, 1989.
2. Hansen, Robert, "Evaporation, Membrane Filtration and Spray Drying". North European Dairy Journal Denmark, 1985.
3. Mact.arthy, D. "Concentration and Drying of Foods", Elsevier Applied Science, 1986.
4. Kessler, H.G. "Food Engineering and Dairy Technology". V.A. Kessler, Germany, 1990.
5. Barbosa - Canovas, V. and Vega - Mercado, H. "Dehydration of Foods", Champman and Hall, New York 1996.

UFET814: OPTIMIZATION TECHNIQUES IN FOOD ENGINEERING

Code: UFET814
Credits: 06
L-T-P: 3-0-0

Introduction: Engineering application of optimization, Formulation of design problems as a mathematical programming problem, Classification of optimization problems.

Linear Programming: Simplex methods, Revised simplex method, Duality in linear programming, post optimality analysis, Transportation and assignment problems.

Non-linear Programming: Unconstrained optimization techniques, Direct search methods, Descent methods, constrained optimization, Direct and Indirect methods.

Dynamic Programming: Introduction, multi decision process, computational procedure.

Suggested Readings

1. Haddley, G. "Linear Programming".
2. Fox, R.L. "Optimization Methods for Engineering Design". Addison Wesley USA., 1971,
3. Kambo, N.S. "Mathematical Programming Technique" .. Affiliated East West Press, New Delhi,
4. Rao, S.S. "Optimization Theory and Application", Wiley Eastern, New Delhi., 1978.

UFET815: MATERIAL SCIENCE AND TECHNOLOGY

Code: UFET815
Credits: 06
L-T-P: 3-0-0

Introduction to Materials: Engineering materials, their classification, characteristics and basic principles for their selection. Structure of atom, and types of bonds. Crystal structure. Defects in crystal structure and their influence on properties of a materials.

Metals and their alloys: Phase equilibrium diagram for iron-carbon and copper-zinc system. Ferrous and none ferrous alloys. Mild steels, special steels, stainless steels, brasses, bronzes, aluminum alloys and titanium alloys. Methods for fabrications-Rolling, forging, extrusion and joining.

Polymers: Types of plastics, structure-Properties, correlation of important plastics, polymerization processes and additives. Fiber reinforced plastics, rubbers and elastomers and applications.

Ceramics and Glass: Structure-properties, correlations oxide and non-oxide ceramics of important plastics, vitreous and borosilicate glasses, glass-ceramics and enamels. Major electrical, optical and mechanical properties of ceramics and glasses. Enameling and glass lining.

Corrosion and its control: Types of corrosion, chemical and electrochemical reactions, methods of corrosion prevention. Corrosion resistant materials.

Suggested Readings

1. James,F.Shackford, "Introduction to Materials Science",Macmillam pub. Co.,NY,1990
2. Jestrazebaski,D.Z., "Properties of Engineering Materials,"3rd ed., Toppen Co. Ltd.
3. Smith, W.F.,"Foundations of Materials Science and Engineering," 2nd Ed., McGraw-Hill, 1993.
4. Raghavan,V., "Materials Science and Engineering," PHI,New Delhi.
5. Van Vlack, L.H., "Materials Science and Engineering," Addison Wesley.

UFET816: SPECIALTY FOODS: NUTRACEUTICALS AND FUNCTIONAL FOODS

Code: UFET816
Credits: 06
L-T-P: 3-0-0

Scope, importance and renewed emphasis on specicality foods, health foods, functional foods, basis of claims for a compound as a nutraceutical, regulatory issues for nutraceuticals including CODEX. Nutraceuticals, infant and baby foods, adolescent/ teen age foods, foods for pregnant ladies and nursing mothers, geriatric foods.

Food recommended and restricted in metabolic disorders and disturbances, gastrointestinal disorders; fever and infection; liver, gall, bladder and pancreatic disturbances; blood, circulatory and cardiac diseases; urinary and musculoskeletal diseases; allergies; Nutritional deficiencie; Beneficial effect of spices, honey, spirulina etc.

Enrichment, value addition, fortification, supplementation, Sources, Significance, Fortification and Enrichment in different foods,Value addition in processed food products

Manufacturing aspects of selected nutraceuticals such as lycopene, isoflavonoids, glucosamine, phytosterols etc.; formulation of functional foods containing nutraceuticals – stability and analytical issues, labelling issues.

Transgenic plant foods with health claims. Usefulness of Probiotics & Prebiotics in gastrointestinal health and other benefits. Prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes

Suggested Readings

1. *'Human Nutrition' by Benzamin 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. *'Nutrition and Dietetic Foods' by Arnold E. Bender, Chem. Pub. Co. New York.*
5. *'Basic Nutrition in Health & Disease' by P. S. Howe, W. B. Saunders Company, London.*