

CENTURION UNIVERSITY OF TECHNOLOGY & MANAGEMENT

B. Tech Phytopharmaceuticals Syllabus



Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

School of Agriculture and Bio Engineering
Centurion University of Technology and Management
Alluri Nagar, P.O. - R Sitapur, Via- Uppalada, Paralakhemundi, Dist: Gajapati – 761211,
Odisha, India
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PROGRAMME OUTLINE

Semester I

SL. No.	Name of The Course	Course Code	Credit's	
			(T)	(P)
1.	Basic Engineering Chemistry	BTPH1101	2	-
2.	Basic Electrical Engineering	FCEL0101	2	-
3.	Basic Electrical Engineering Laboratory	FCEL0202	-	1
4.	Comprehensive and communication skills in English	ASEL1101	2	1
5.	Basic Concepts of Ayurveda, Human Anatomy & Physiology	CCAY0101	3	-
6.	Basic Engineering Chemistry Laboratory	BTPH1201	-	1
7.	Workshop Practice	BTME0401	1	2
8.	Environmental Science	FCAG0101	2	-
9.	Thermodynamics & Mechanics	CCME0401	2	1
10.	Mathematics Bridge Course	BTPH1102	2	-
11.	NSS	BTHU0102	-	-
		Total	16	6

Semester II

SL. No.	Name of The Course	Course Code	Credit's	
			(T)	(P)
1.	Pharmacognosy-Concepts of Authenticity & Analytical Chemistry	CCAY0402	2	1
2.	Engineering Mathematics	BTAG1101	3	-
3.	Basic Electronics Engineering	FCEC0101	2	-
4.	Basic Electronics Laboratory	FCEC0201	-	2
5.	Engineering Physics	FCPH0102	2	-
6.	Physics Laboratory	FCPH0202	-	2
7.	IOT Enabled Systems	FCIT0101	-	2

8.	Engineering Drawing	FCME0202	-	2
9.	Automation and Mechatronics	DEME0401	1	1
10.	Minor Project (BIOVIA Discovery Studio)	CCAY0301	-	1
		Total	10	11

Semester III

SL. No.	Name of The Course	Course Code	Credit's	
			(T)	(P)
1.	Fermentation-Technology and Ayurveda	CCAY0403	2	1
2.	Plant Design and Operation for Herbal Drugs	CCAY0104	2	-
3.	Phytochemistry Of Commercially Important Herbs	CCCH0101	3	-
4.	Regulations & Certifications of Herbal Drugs	CCAY0105	3	-
5.	Material Science of Excipients and Additives	CCAY0106	3	-
6.	Pharmacology	CCCM0201	2	1
7.	Phytochemistry Laboratory	CCCH0202	-	2
8.	Interpersonal Skills, Entrepreneurship and Start up	DEMG0101	1	-
9.	Human Values and Professional Ethics	BSRT2404	1	-
		Total	17	4

Semester IV

SL. No.	Name of The Course	Course Code	Credit's	
			(T)	(P)
1.	Pharmaceutical Technology-I	CCPY0101	3	-
2.	Pharmaceutical Technology-I Laboratory	CCPY0202	-	3
3.	Advanced Extraction Technologies	CCCM0102	3	-

4.	Advanced Extraction Laboratory	CCCM0203	-	3
5.	Statistical Quality Control & Production Management	CCMA0101	2	-
6.	Design of Experiments	CCMA0101	2	-
7.	Industrial Training During Summer Break	CCII1301	3	3
		Total	13	9

Semester V

SL. No.	Name of The Course	Course Code	Credit's	
			(T)	(P)
1.	Pharmaceutical Technology-II	CCPY0103	3	-
2.	Pharmaceutical Technology-II Laboratory	CCPY0204	-	3
3.	Analytical Instrumentation for Herbal Products	CCAY0107	3	-
4.	Analytical Instrumentation for Herbal Products Laboratory	CCAY0208	-	3
5.	Intellectual Property Rights and Applications	FCIP0101	2	-
6.	Packaging Technologies	CCCM0104	3	-
7.	Minor Project	CCAY0303	-	1
		Total	11	7

Semester VI

SL. No.	Name of The Course	Course Code	Credit's	
			(T)	(P)
1.	Herbal Cosmetic Technology	CCAY0109	3	-
2.	Measurement Analysis	CCIB0101	3	-
3.	Open Elective	(A/B/C/D)	2	-
4.	Open Elective	(A/B/C/D)	2	-
5.	Open Elective	(A/B/C/D)	2	-
6.	Minor Project	CCAY0310	-	3

7.	Industrial Training During Summer Break	CCIB1301	3	3
			15	6

Semester VII

SL. No.	Name of The Course	Course Code	Credit's	
			(T)	(P)
1.	Downstream Processing of Phytopharmaceuticals	CCAY0111	3	-
2.	Heat & Mass Transfer Operations	FCCM0101	3	-
3.	Open Elective	(A/B/C/D)	3	-
4.	Open Elective	(A/B/C/D)	3	-
5.	Professional Elective	E	3	-
6.	Downstream Processing Laboratory	CCAY0212	-	3
		Total	15	3

Semester VIII

SL. No.	Name Of The Course	Course Code	Credit's	
			(T)	(P)
1.	Project Work-Major	CCAY0313	14	3
		Total	14	3

Theory (T)

Practical (P)

Total Number of Credits= 160

Theory Credits=111

Practical Credits=49

ELECTIVES

(A) QUALITY, REGULATORY & CERTIFICATIONS

SL. No.	Name of The Course	Course Code	Credit's	
			(T)	(P)
1.	FSSAI Rules and Regulations, Standards (BIS/EU/) & Clinical Trails	DEAY0101	2	-
2.	Regulatory Affairs Relevant to Ayurvedic Industry	DEAY0102	2	-
3.	HACCP/HALAL/Organic Certifications/Fair Trade	DEAY0103	2	-
4.	Good Agricultural and Collection Practices	DEAG0101	3	-
5.	Quality Assurance and Quality Control Of Herbal Products	DEAY0104	2	-
		Total	11	-

(B) MANUFACTURING & PRODUCTION PLANNING

SL. No.	Name of The Course	Course Code	Credit's	
			(T)	(P)
1.	Production Planning & Inventory Control	DEMG0102	3	-
2.	Supply Chain Management	DEMG0103	3	-
3.	Disaster Management and Industrial Safety	DEMG0104	3	-
4.	Good Manufacturing Practices-Herbal Industry	DEMG0105	3	-
5.	Sustainable Manufacturing Practices	DEMG0106	3	-
6.	Employee Relations & Training	DEMG0107	3	-
		Total	18	-

(C) MARKETING & SALES

SL. No.	Name of The Course	Course Code	Credit's	
			(T)	(P)

1.	Entrepreneurship	DEMG0108	3	-
2.	Branding & Marketing	DEMG0109	3	-
3.	Digital Marketing	DEMG0110	3	-
4.	Sales & Distribution	DEMG0111	3	-
5.	Product Promotion	DEMG0112	3	-
6.	Consumer Research	DEMG0113	3	-
		Total	18	-

(D) RESEARCH & DEVELOPMENT

SL. No.	Name of The Course	Course Code	Credit's	
			(T)	(P)
1.	Development of Phytopharmaceuticals	DEAY0106	3	-
2.	Basics of Biological Screening	DEAY0107	3	-
3.	Basics of Plant Biotechnology	DEAY0108	3	-
4.	Herbal Nanotechnology	DEAY0109	3	-
5.	Introduction to Food Technology	DEAY0110	3	-
		Total	15	-

(E) PROFESSIONAL ELECTIVES

SL. No.	Name of The Course	Course Code	Credit's	
			(T)	(P)
1.	Negotiation and Conflict Resolution Skills	DEMG0114	3	-
2.	Basic Email Etiquette	DEMG0115	3	-
3.	Presentation Skills and Group Discussion	DEMG0116	3	-
4.	Interpersonal Skills/Listening and Speaking	DEAY0112	3	-
5.	Research Report Writing	DEAY0113	3	-
6.	Business Communication	DEAY0114	3	-
		Total	18	-

SYLLABUS

SEMESTER-I

BTPH1101 Basic Engineering Chemistry Credits: 2 (2+0)

Theory

Water Analysis: Importance of water, different types of water, sources and uses of water, types of water pollutants and domestic and industrial significance of analysis of water. concept of pH and pOH and their scale. Acids and bases: Bronsted Lewis concepts of acids and bases, dissociation constants of acids and bases. Salt-their hydrolysis. Buffer solutions. Derivation of Henderson – Hassel Bach equation and its application, buffer capacity. Colloids: classification. Properties. Enzymes and their use in the manufacturing of ethanol. Principles of food chemistry. Introduction to lipids, proteins, carbohydrates, vitamins, food preservatives, colouring and flavouring reagents of food. Introduction to Analytical methods like thermo-gravimetric, Differential scanning calorimetry. UV-VIS &IR spectroscopy, X-Ray diffraction, Electron Microscopy, Chromatography (Paper Chromatography, TLC, HPLC, G.C, L.C).

Suggested Reading

Jain P L and Jain M. 1994. Engineering Chemistry. Danpat Rai publishing company Pvt. Ltd., Delhi. Bahl B S, Arun Bahl and Tuli B D. 2007.

Essentials of Physical Chemistry. S.Chand and Co. Ltd., Delhi.

BTPH1201 Basic Engineering Chemistry Lab Credits: 1 (0+1)

Practical

Preparation of a buffer solution. Determination pH of buffer solution, Determination of temporary and permanent hardness of water by EDTA method, Estimation of available chlorine in bleaching powder, Estimation of activity of water sample: Estimation of alkalinity of water sample: Determination of carbonate and non- carbonate hardness by soda reagent, Determination of X max and verification of Beer Lambert Law: , Chromatographic analysis: Determination of molar refraction of organic compounds. (paper chromatography, TLC)

Suggested Reading

Jain P L and Jain M. 1994. Engineering Chemistry. Danpat Rai publishing company Pvt. Ltd., Delhi. Bahl B S, Arun Bahl and Tuli B D. 2007.

Essentials of Physical Chemistry. S.Chand and Co. Ltd., Delhi.

FCEL0101 Basic Electrical Engineering Credits: 2(2+0)

Essence of electricity, Electric field; electric current, potential and potential difference, emf, electric power, ohm's law, basic circuit components, Ideal and Practical Sources, Source Conversion, Induced EMF, Energy Stored in Inductor & Capacitor. Laws and Theorems applicable to DC networks (KCL & KVL, Node voltage & Mesh current analysis, Delta-Star & Star-Delta conversion, Superposition principle, Thevenin & Norton theorem). Construction, Classification and Principle of operation of DC machines, EMF equation of DC generator, Speed Equation of DC Motor. Single-phase EMF Generation, Waveform and Phasor Representation, Average and Effective value of sinusoids, Peak factor & Form factor, Complex Impedance and Power using j-operator, Power factor. Comparison between single-phase and three-phase systems, Three-phase EMF Generation, Line and Phase quantities in star and delta networks, Power and its measurement in three-phase balanced circuits. Construction and principle of operation, EMF Equation, Transformation ratio, Practical and Ideal transformers, Transformer losses, transformer rating. Introduction to Three-phase and Single-phase Induction Motors, Concept of Slip, Slip-Torque characteristics (no derivations). Introduction, PMMC Ammeters and Voltmeters with extension of range, Moving-Iron Ammeters and Voltmeters, Study of Digital Voltmeters and Multimeters, Dynamometer type Wattmeter, Energy meter. Brief idea about various generating plants (Thermal, Hydel, and Nuclear), Transmission, Distribution and Utilization of Electric Energy. Brief information of VFD drives, V belts and transmission of power.

Suggested Reading

B.L.Theraja, A.K.Theraja "A textbook of Electrical Technology" Vol-1 & 2, S.Chand & Co. Ltd.

Hughes, "Electrical & Electronic Technology", Ninth Edition (Revised by J Hiley, K Brown, and I Smith), Pearson Education.

FCEL0202 Basic Electrical Engineering Laboratory 1(0+1)

Practical

Connection & Measurement of power consumption of a fluorescent lamp, Measurement of armature & field resistances of a D.C Compound Machine, Connection & Testing of 1- \emptyset Energy Meter, Calculation of No-Load losses of a 1- \emptyset Transformer, Study of 1- \emptyset induction motor or fan motor, Determination of OCC (Open Circuit Characteristics) of D.C Shunt Generator, Starting of 3- \emptyset induction motor by star-delta (Y- Δ) starter or DOL starter, Calculation of current, voltage, power & power factor of series RLC circuit excited by 1- \emptyset A.C Supply, V-I Characteristics of Incandescent lamp, Verification of Thevenin's theorem, Study of DC motor using three-point starter.

Suggested Reading

V.K.Mehta, "Principles of Electrical Engineering and Electronics" S.Chand& Co. Ltd.

Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice-Hall of India,

BTME0401 Workshop Practice Credits: 3(1+2)

Theory

Introduction: workshop practice, safety, care and precautions in workshop. Wood working tools and their use, Heat treatment process: Hardening, tempering, annealing and normalizing etc. Metal work: Metal cutting. Soldering, Brazing. Welding: Electric arc and Gas welding. Smithy and forging operations: tools and equipment's. Bench work: The bench, flat surface filing, chipping, scrapping, marking out, drilling and screwing. Introduction to following tool machines: (a) Lathe Machine (b) Milling Machine (C) Shaper and Planner (d) Drilling and Boring machines (e) Grinder (f) CNC Machines etc.

Practical

To study different types of measuring tools used in metrology and determine least counts of Verniercallipers, micrometres and Vernier height gauges. Job work on filing and chipping. To study different types of fitting tools and marking tools used in fitting practice. To study different types of machine tools (lathe, milling, drilling machines etc.). To prepare a job on a lathe involving facing, outside turning, taper turning, step turning, radius making, threading etc.

Suggested Readings

Khurmi R S and Gupta J K. A Text Book of Workshop Technology (Manufacturing processes), S.Chand&Company Ltd., New Delhi.

Workshop Practice –B.L.Juneja.Workshop Practice –R.K.Rajput.

ASEL1101 Comprehensive and Communication Skills in English Credits: 3(2+1)

Theory

War Minus Shooting- The sporting Spirit. A Dilemma- A layman looks at science Raymond B. Fosdick. You and Your English – Spoken English and broken English G.B. Shaw. Reading Comprehension, Vocabulary- Antonym, Synonym, Homophones, Homonyms, often confused words. Exercises to Help the students in the enrichment of vocabulary based on TOEFL and other competitive examinations. Functional grammar: Articles, Prepositions, Verb, Subject-verb Agreement, Transformation, Synthesis, Direct and Indirect Narration. Written Skills: Paragraph writing, Precise writing, Report writing and Proposal writing. The Style: Importance of professional writing. Preparation of Curriculum Vitae and Job applications. Synopsis Writing. Interviews: kinds, Importance and process.

Practical

Listening Comprehension: Listening to short talks lectures, speeches (scientific, commercial and general in nature). Oral Communication: Phonetics, stress and intonation, Conversation practice. Conversation: rate of speech, clarity of voice, speaking and Listening, politeness & Reading skills: reading dialogues, rapid reading, intensive reading, improving reading skills. Mock Interviews: testing initiative, team spirit, leadership, intellectual ability. Group Discussions.

Suggested Readings

Balasubramanian, T. 1989. A Text Book of Phonetics for Indian Student, Orient Longman, New Delhi.

Balasubramanyam, M. 1985. Business Communication. Vani Education Books, New Delhi.

Jean Naterop,B. and Rod Revell. 1977. Telephoning in English. Cambridge University Press, Cambridge.

Krishna Mohan and Meera Banerjee. 1990. Developing Communication Skills. McMillan India Ltd.,New Delhi.

Krishanswamy, N and Sriramman,T. 1985. Current English for Colleges. Mc Millan India Ltd.,Madras.

Narayanaswamy V R. 1979. Strengthen Your Writing. Orient Longman, New Delhi.

Sharma R C and Krishna Mohan. 1978. Business Correspondence. Tata Mc Graw Hill Publishing Company., New Delhi.

Theory

Environmental Studies: Scope and importance. Natural Resources: Renewable and non-renewable resources. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. d) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Ecosystems: Concept, Structure, function, Producers, consumers, decomposers, Energy flow, ecological succession, food chains, food webs, ecological pyramids. Introduction, types, characteristic features, structure and function of the forest, grassland, desert and aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystem diversity and bio-geographical regions of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. India as a mega-diversity nation. Hotspots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man- wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Environmental Pollution: definition, cause, effects and control measures of a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Pollution case studies. Water conservation, rainwater harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion. Wasteland reclamation. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act, Biodiversity Act. Issues involved in enforcement of environmental legislation. Role of Information Technology

Suggested Reading

BharuchaErach. 2005. Text Book of Environmental Studies for Undergraduate Courses. University Grants Commission, University Press, Hyderabad.

Sharma J P. 2003. Introduction to Environment Science. Lakshmi Publications.

Chary Manohar and Jaya Ram Reddy. 2004. Principles of Environmental Studies. BS Publishers, Hyderabad.

Kaul S N, Ashuthosh Gautam. 2002. Water and Waste Water Analysis. Days Publishing House, Delhi.

Gupta P K. 2004. Methods in Environmental Analysis – Water. Soil and Air. Agro bios, Jodhpur.

CCME0401 Thermodynamics & Mechanics Credits: 3 (2+1)

Theory

Thermodynamics properties, closed and open system, laws of thermodynamics, internal energy.. First law applied to steady flow processes. Carnot cycle, Carnot theorem. Entropy, physical concept of entropy, Otto, diesel and dual cycles. Principles of refrigeration, - units, terminology, production of low temperatures, air refrigerators working on reverse Carnot cycle and Bell Coleman cycle. Vapour refrigeration-mechanism, P-V,P-S,P-H diagrams, vapor compression cycles, dry and wet compression, super heating and sub cooling. Vapour absorption refrigeration system. Common refrigerants and their properties. Design calculations for refrigeration system. Cold storage plants. Thermodynamic properties of moist air, perfect gas relationship for approximate calculation, adiabatic saturation process, wet bulb temperature and its measurement, psychometric chart and its use, elementary psychometric process. Air conditioning – principles –Type and functions of air conditioning, physiological principles in air conditioning, air distribution and duct design methods, fundamentals of design of complete air conditioning systems – humidifiers and dehumidifiers – cooling load calculations, types of air conditioners – applications.

Practical

Tutorials on thermodynamic air cycles, Study and application of P V and T S chart in refrigeration, P H chart (or) Mollier diagram in refrigeration, Numerical on air refrigeration cycle systems, Numerical on vapour compression cycle refrigeration system, Study of domestic water cooler, Study of domestic household refrigerator, Study of absorption type solar refrigeration system, Study cold storage for fruit and vegetables, Freezing load and time calculations for food materials, Determination of refrigeration parameters using refrigeration tutor – II, Numerical on design of air conditioning systems, Study of window air conditioner, Study on repair and maintenance of refrigeration and air- conditioning systems. Visit to chilling or ice making and cold storage plants.

Suggested Reading

Kothandaraman C P Khajuria P R and Arora S C. 1992. A Course in Thermodynamics and Heat Engines. Dhanpat Rai and Sons, 1682 Nai Sarak, New Delhi.

Khurmi R S. 1992. Engineering Thermodynamics. S Chand and Co. Ltd., Ram Nagar, New Delhi. Mathur M L and Mehta F S. 1992. Thermodynamics and Heat Power Engineering. Dhanpat Rai and Sons 1682 Nai Sarak, New Delhi.

Ballney P. L. 1994. Thermal Engineering. Khanna Publishers, New Delhi.

Nag P K. 1995. Engineering Thermodynamics. Tata McGraw Hill Publishing Co.Ltd., 12/4 Asaf Ali Raod, New Delhi.

CCAY0101 Basic Concepts of Ayurveda And Human Anatomy & Physiology

Credits :3(3+0)

Theory

Definition of Ayu and Ayurveda with introduction to Ashtanga Ayurveda. History of Ayurveda definition and importance of Padartha vignana. Importance and complete information of daily routines, practices food regime etc. Complete information about basics of Vata, Pitta and Kapha, importance of food and its practice. Structure of cell, its components and their functions- Elementary Tissues of the Human Body- Osseous System: Structure, composition and functions of skeleton Classification of joints, types of movements of joints, Disorders of joints- Skeletal Muscles: Gross anatomy; physiology of muscle contraction, physiological properties of skeletal muscles and their disorders. Haemopoietic System: Composition and functions of blood and its elements, their disorders, blood groups and their significance, mechanism of coagulation, disorders of platelets and coagulation-. Lymph and Lymphatic System: Composition, formulation and circulation of lymph; disorders of lymph and lymphatic system- Basic physiology and functions of spleen- Cardiovascular System: Basic anatomy of the heart, Physiology of heart, blood vessels and circulation- Digestive System- Respiratory System- Metabolism and Energetics-Urinary System- Reproductive System.

Suggested Reading

Padartha Vigyan Acharya Ramkrishna Pathak

Ayurved Darshan Vaidya Ranjit Rai

Ayurvediya Padarth Vigyan Dr. Ayodhya Prasad Achai

Ayurvediya Padarth Vigyan Vaidya Ramkrishna Sharma

Ross and Wilson Anatomy and Physiology in Health and Illness –Publisher: Churchill Livingstone Elsevier. London.

Human Physiology-by C.C. Chatterjee, Publisher: CBS Publishers & Distributors, Bengaluru

Fundamentals of Anatomy & Physiology-by Judi L. Nath, Edwin F. Bartholomew, Frederic H. Martini, Pearson Publishing Company. New York.

BTPH1102 Maths Bridge Course Credits: 2(2+0)

Theory

Matrices, vector addition, multiplication of vectors, Basic concept of trigonometry, limits and continuity, derivative, Complex numbers, partial fractions, integration, definite Integration, differential equations.

Suggested Readings

Advanced Engineering Mathematics by E. Kreyszig Publisher: Johnwiley& Sons Inc-8th Edition

Higher Engineering Mathematics by B.V. Raman Publisher: TMH

Advanced Engineering Mathematics by P.V.O' Neil Publisher: Thomson

Mathematical Methods by Potter &Goldberg; Publisher: PHI

Semester II

CCAY0402 Pharmacognosy-Concepts of Authenticity & Analytical Chemistry

Credits: 3(2+1)

Theory

Definition, history, scope of Pharmacognosy in indigenous system of medicine; Sources of drugs- Biological, marine, mineral and modern techniques like plant tissue cultures as sources of drugs; Classification of drugs and natural origin- Alphabetical, morphological, taxonomical, chemical and pharmacological classification of drugs. Demand and supply of crude drugs and their regulations with reference to trade and biodiversity; Adulteration, Quality control and drug evaluation: Significance of Pharmacopoeia standards. Detection of adulteration by organoleptic, macroscopic and microscopic methods; An introduction to various active constituents and their isolation, classification and properties. Ex: alkaloids, terpenoids, glycosides, volatile oils, tannins and resins. Occurrence, distribution, organoleptic

evaluation, chemical constituents including tests wherever applicable and therapeutic efficacy of following categories of drugs. Laxatives- Aloes, Castor, Ispaghula, Senna; Cardiotonic- Digitalis, Arjuna; Carminatives & G.I. regulators- Umbelliferous fruits, Cardamom, Ginger, Black pepper, Asafoetida, Nutmeg, Cinnamon, Clove; Astringents- Catechu; Drugs acting on nervous system- Hyoscyamus, Ashwagandha, Ephedra, Opium, Cannabis, Nux-vomica; Antihypertensive- Rauwolfia; Antitussives- Vasaka, Tulsi; Antirheumatics- Guggal, Antitumour- Vinca; Antidiabetics- Pterocarpus, Gymnemasylvestris; Diuretics- Gokhru, Punarnava; Antidysenterics- Ipecacuanha; Antiseptics and disinfectants- Neem, Curcuma; Antimalarials- Artemisia; Vitamins- Shark liver oil and Amla; Enzymes- Papaya, Diastase; Perfumes and flavouring agents- peppermint oil, Lemon oil, Orange oil, lemon grass oil, sandal wood; Pharmaceutical aids-Honey, Arachis oil, starch, kaolin, pectin, olive oil, Lanolin, Beeswax, Alginate, Agar, Guar gum, Gelatin; Miscellaneous drugs- Liquorice, Garlic, Picrorhiza, Dirscorea, Linseed, Shatavari, Shankhpushpi, Pyrethrum, Tobacco.

Suggested readings

Trease and Evan's Pharmacognosy by William Evans, Elsevier Ltd.

Pharmacognosy by C. K. Kokate, NiraliPrakashan, Delhi

Practical Pharmacognosy by C. K. Kokate, Vallabh Prakashan, Delhi

Demand and Supply of Medicinal Plants in India by D K Ved & G S Goraya, FRLHT, Bangalore

BTAG1101

Engineering Mathematics

Credits: 3 (3+0)

Theory

Linear Algebra, Basic Concepts, Linear System of Equations, Solution by Gauss Elimination, Conditions of Existence and Uniqueness of Solutions, Rank of a Matrix, Linear Dependence and Independence, Linear Transformation, Gauss-Jordan method to find inverse of a matrix, Eigen Values and Eigen Vectors, Basis, Symmetric, Skew-Symmetric and Orthogonal Matrices, Complex Matrices, Similarity of Matrices, Diagonalization., First Order Differential Equations: Exact Differential Equations, Integrating Factor, Linear Differential Equations, Bernoulli Equation. Second & Higher Order Linear Differential Equations: Linear Dependence and Independence of Solutions, Wronskian, Constant Coefficient Homogeneous Equations, Cauchy-Euler Equation, Non-homogeneous Equations, Method of Variation of

Parameter, Method of Inverse Operator, Legendre Equation, Laplace Transforms, Transforms of Derivatives and Integrals, Derivatives and Integrals of Transforms, Shifting Properties, Unit Step Function, Dirac's Delta Function, Convolution, Inverse Transforms, Solution to Differential Equation, System of Differential Equations.

Suggested Readings

Advanced Engineering Mathematics by E. Kreyszig Publisher: Johnwiley& Sons Inc-8th Edition

Higher Engineering Mathematics by B.V. Raman Publisher: TMH

Advanced Engineering Mathematics by P.V.O' Neil Publisher: Thomson

Mathematical Methods by Potter &Goldberg; Publisher: PHI

FCEC0101 Basic Electronics Engineering Credits: 2 (2+0)

Theory

Semiconductors. p—n junction. V—I characteristics of p—n junction. diode as a circuit element. rectifier. clipper. clamper, voltage multiplier, capacitive filter. diode circuits for OR & AND (both positive and negative logic), bipolar junction transistor: operating point. Classification (A,B & C) of amplifier. various biasing methods (fixed. Self-potential divider). H-parameter model of a transistor. analysis of small signal. CE amplifier. phase shift oscillator, analysis of differential amplifier using transistor. ideal OP-AMP characteristics. linear and non-linear applications of OP-AMP (adder. subtractor. integrator, active rectifier. comparator. differentiator. differential, instrumentation amplifier and oscillator). zener diode voltage regulator. transistor series regulator. current limiting. OP-AMP voltage regulators. Basic theorem of Boolean algebra. Combinational logic circuits (basic gates. SOP rule and Kmap). binary ladder D/A converter, successive approximation A/D converter, generalized instrumentation, measurement of displacement. temperature. velocity, force and pressure using potentiometer. Resistance thermometer. Thermocouples. LVDT. Strain gauge and tacho- generator.

Suggested Reading

Mehta V K. Principles of Electronics. S. Chand and Co., New Delhi.

Shaney A K. Measurement of Electronics and Electronic Instrumentation. Khanna Publications.

FCEC020 Basic Electronics Laboratory Credits: 2(0+2)

Practical

To study V-I characteristics of p-n junction diode: To study half wave. full wave and bridge rectifier: To study transistor characteristics in CE configurations: To design and study fixed and self-bias transistor: To design and study potential divider bias transistor: To study a diode as clipper and clamper: To study a OP-AMP IC 741 as inverting and non- inverting amplifier: To study a OP-AMP IC 741 as differentiator and integrator to study a differential amplifier using two transistor: To study a OP-AMP IC 741 as differential amplifier: To study a zener regulator circuit: To study a OP-AMP IC 741 as a active rectifier: To study a OP-AMP IC 741 as a comparator: To familiarize with various types of transducers.

Suggested Reading

Roy Chowdary. Integrated Electronics. John Wiley International.

Kumar Anand. Digital Electronics. A. PHI.

Gupta Sanjeev, Sonthosh Gupta. Electronic Devices and Circuits. Danapath Rai Publications.

FCPH0102

Engineering Physics

Credits: 2 (2+0)

Theory

Dia, Para and ferromagnetism-classification. Langevin theory of dia and Para magnetism. Adiabatic demagnetization. Weiss molecular field theory and ferromagnetism. Curie-Weiss law. Wave particle quality, de-Broglie concept, uncertainty principle. Wave function. Time dependent and time independent Schrodinger wave equation, Qualitative explanation of Zeeman effect, Stark effect and Paschan Back effect, Raman spectroscopy. Statement of Bloch's function. Bands in solids, velocity of Bloch's electron and effective mass. Distinction between metals. insulators and semiconductors. Intrinsic and extrinsic semiconductors, law of mass action. Determination of energy gap in semiconductors. Donors and acceptor levels. Superconductivity, critical magnetic field. Meissner effect. Isotope effect. Type-I and II superconductors, Josephson's effect DC and AC, Squids. Introduction to high T_c superconductors. Spontaneous and stimulated emission, Einstein A and B coefficients. Population inversion, He-Ne and Ruby lasers. Ammonia and Ruby masers, HolographyNote. Optical fiber. Physical structure. basic theory. Mode type, input output characteristics of optical fiber and applications. Illumination: laws of illumination, luminous flux, luminous intensity, candle power, brightness.

Suggested Reading

Brijlal and Subrahmanyam. Text Book of optics. S. Chand and Co., New Delhi. Sarkar Subir Kumar. Optical State Physics and Fiber Optics. S. Chand and Co., New Delhi.

FCPH0202 Physics Laboratory Credits: 2 (0+2)

Practical

To find the frequency of A.C. supply using an electrical vibrator; To find the low resistance using Carey Foster bridge without calibrating the bridge wire; To determine dielectric constant of material using De Sauty's bridge; To determine the value of specific charge (e/m) for electrons by helical method; To study the induced e.m.f. as a function of velocity of the magnet; To obtain hysteresis curve (B-H curve) on a C.R.O. and to determine related magnetic quantities; To study the variation of magnetic field with distance along the axis of a current carrying circular coil and to detuning the radius of the coil; To determine the energy band gap in a semiconductor using a p-n Junction diode; To determine the slit width from Fraunhofer diffraction pattern using laser beam; To find the numerical aperture of optical fibre: To set up the fibre optic analogue and digital link; To study the phase relationships in L.R. circuit; To study LCR circuit; To study the variations of thermo emf of a copper-constantan thermo-couple with temperature; To find the wave length of light by prism.

Suggested Reading

Gupta S L, Kumar V Sharma R C. Elements of Spectroscopy. Pragati Prakasam, Meeruth. Saxena B S and Gupta R C. Solid State Physics. Pragati Prakasam, Meeruth. Srivastava B N. Essentials of Quantum Mechanics. Pragati Prakasam, Meeruth. Vasudeva D N. Fundamentals of Magnetism and Electricity. S. Chand and Co., New Delhi.

FCIT0101 IOT Enabled Systems Credits: 2 (0+2)

Practical

Internet of Things: Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IT enabled Technologies, Communication protocols, Domain Specific IoTs: Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle Embedded Systems: Introduction, Sensors and Actuators, Different types of Sensors, Raspberry Pi: Configuration of OS on to Raspberry Pi, Commands used in Raspberry Pi coding (Linux), Raspberry Pi pin descriptions. Experiments like the following will be performed: Simple LED Blink Example, Simple Pattern of LED, Complex Pattern of LED, Simple Automated Light System using LDR, Simple project on Temperature Sensor using LCD display, LED action via Bluetooth

Experiments like the following will be performed: Ultra Sonic Sensor of Distance Finder, Data Logger with Temperature Sensor and LDR, Cloud Access and Storage of Sensor Data, IR Module Interfacing, PIR Module Interfacing, Relay Module Interfacing. Network setup WIFI/LAN, LED blinking using Pi, Web Monitoring of Sensor outputs through API keys, Sensor based automated E-Mail Sending through Pi.

Suggested Readings

Maneesh Rao, Internet of Things with Raspberry Pi 3, Packt Publishing Limited, April 2018
McEwen Adrian and Cassimally Hakim, Designing the Internet of Things, Wiley Publication, 2013.

BahgaArshdeep and Madisetti Vijay, Internet of Things - A Hands-on Approach, Universities Press, 2015.

Richardson Matt & Wallace Shawn, Getting Started with Raspberry Pi, O'Reilly (SPD), 2014.

FCME0202 Engineering Drawing Credits: 2(0+2)

Practical

Introduction of drawing scales; First and third angle methods of projection. Principles of orthographic projections; projection of points, lines and solids; Section of solids and Interpenetration of solid surfaces; Development of surfaces of geometrical solids; Isometric projection of geometrical solids. Preparation of working drawing from isometric views. Different methods of dimensioning. Concept of sectioning. Revolved and oblique sections. Sectional drawing of simple machine parts. Types of rivet heads and riveted joints. Symbols for different types of welded joints. Nomenclature, thread profiles, multi start threads, left and right-hand threads. Square headed and hexagonal nuts and bolts. Conventional representation of threads. Different types of lock nuts, studs, machine screws, cap screws and wood screws. Foundation bolts. Forms of screw threads, representation of threads, Bolts-headed centre, stud screws, set screws, butt, hexagonal and square; keys-types, taper, rank taper, hollow saddle etc.

Suggested Reading

Bhat N D. 2010. Elementary Engineering Drawing. Charotar Publishing House Pvt. Ltd., Anand. Bhatt N D and Panchal V M. 2013. Machine Drawing. Charotar Publishing House Pvt. Ltd., Anand. Narayana K L and Kannaiah P. 2010. Machine Drawing. Scitech Publications (India) Pvt. Ltd., Chennai.

Theory

Introduction to Automation: What is Automation, Brief history of Automation, Automation Uses, Automation - PLC Basics, Mechanical relays versus PLC, PLC Architecture, Functions of various blocks, working principle of PLC, Memory types, Concept of PLC Scan cycle. PLC Hardware & Terminology: PLC Memory Organization, Various Types of Addressing Used within a PLC, PLC Programming input instructions, concept of sink and source input/output. Programming PLC's : Types of programming, Differences between Types of Programming, construction of PLC ladder diagrams, Controlling Program Flow in a Ladder Logic Program. Timers and Counters: Use of timers and counters within a ladder logic program, Basic concepts of function blocks. PLC Communication: Describe common types of data communications and their characteristics, Use Ethernet TCP/IP protocol, Troubleshoot communication systems in PLC. Introduction To SCADA : Introduction and SCADA Basics: General SCADA theory, Importance of SCADA in Industrial Automation, , Features of SCADA, Architecture of SCADA (Open & Proprietary). In-Touch : Introduction to In-Touch: Basic operations related to In Touch Editor, types of windows, How to Open window, windows property.

Practical

Study of hardware of AB and SIEMEN'S PLC. Digital logic gates programming using ladder logic program. Boolean Expression using ladder logic program. Ladder diagrams for process control. Study of latching and unlatching of motor. Chemical vessel reactor. Sequential operation of ON/OFF of a set of lights. Forward and reverse direction control of motors. Operation of Traffic signal simulator. Conveyor belt programming

Suggested Reading

Gary Dunning "Introduction to Programmable Logic Controller"

Frank D. Petruzella "Programmable Logic Controllers"

L.A. Bryan, E.A Byran, "Programmable Controllers", Second Edition

Semester III**CCAY0403 Fermentation Technology in the Context of Ayurveda Credits:3 (2+1)****Theory**

Definition of Bhaishajya Kalpana, Mana paribhasha (Introduction, measurements given in AFI- I), Collection, storage and preservation of raw material. Introduction to various dosage

forms with Principles and procedures in mixtures, solutions, Emulsions, Churnas, Kwath churnas, Powders (Bhasmas etc.), external preparations, suppositories, basti, asavarishta, vati, gutika etc. Sandhana kalpana [Definition, types-names (description of Asavarista only), method, parikshavidhi, dose, anupana, shelf- life, use, packing and storage.

Practical

Preparation of Kwatha/Kashya and their quality parameters, Preparation of Medicated Taila/Oils/Lehya, Preparation of Asava and Arista.

Suggested Readings

Bhaishjya Ratnavali

Sharangadhara Samhita

CCAY0104 Plant Design and Operation for Herbal Drugs (3)

Theory

General design considerations, Process design development, Layout of plant items, Flow sheets and PI diagrams, Economic aspects and Optimum design, Practical considerations in design and engineering ethics. Water: Water resources, Storage and characterization, Conditioning. Steam - Boilers, Steam Handling and distribution, Steam nozzles, Condensate utilization, Steam traps, Flash tank analysis, Safety valves, Pressure reduction valves, Desuperheaters. Air - Air compressors, Vacuum pumps, Air receivers, Distribution systems, Different types of ejectors, Air dryers. Energy Conservation - Analysis of scope and potential for energy conservation, Good housekeeping practice, Thermal insulation, Efficiency improvement in boilers, furnaces and heat recovery techniques, Energy conservation in HVAC systems, Electrical energy conservation; analysis of motor, analysis of pumps, Process integration as a measure of energy conservation, Optimization of steam system, Energy saving opportunities with compressed air systems and cooling towers. Analysis of Cost estimation - Factors affecting Investment and production costs, Estimation of capital investment and total product costs, Interest, Time value of money, Taxes and Fixed charges, Salvage value, Methods of calculating depreciation, Profitability, Alternative investments and replacements.

Optimum Design and Design Strategy: Break-even analysis, Optimum production rates in plant operation, Optimum batch cycle time applied to evaporator and filter press, Economic pipe diameter, Optimum insulation thickness, Optimum cooling water flow rate and optimum distillation reflux ratio.

Suggested Readings

Peters, M.A. and Timmerhaus, K.D., Plant Design and Economics for Chemical Engineers, McGraw Hill (2003).

Anil Kumar, Chemical Process Synthesis and Engineering Design, Tata McGraw Hill (1982).

Ulrich, G.D., A Guide to Chemical Engineering Process Design and Economics, John Wiley & Sons (1984).

Nagabhushan Raju, K., Industrial Energy Conservation Techniques: Concepts, Applications and Case Studies, Atlantic Publishers & Distributors (2007).

CCCH0101 Phytochemistry Of Commercially Important Herbs Credits: 3(3+0)

Theory

Concept note on commercial medicinal and aromatic plants (MAPs). Collection, cultivation and trade of MAPs. Relationship between conservation sites and richness of MAPs. Commercial MAPs of India. Promoting medicinal plants cultivation as a tool for biodiversity conservation. Yield assessment and cost-benefit analysis. Role of National Medicinal Plant Board (NMPB) in Promotion of MAPs. Marketing of Medicinal Plants: Challenges and Strategies. Methods of extraction, isolation and characterization of natural products. Various separation techniques used for isolation of natural products. Biosynthetic pathways. Primary metabolites, their examples. Secondary metabolites, various classes of secondary metabolites (e.g. Alkaloids, glycosides, tannins, lignans, saponins, lipids, flavonoids, coumarins etc.). Here most important part is chemistry of these classes. Important therapeutic classes: anti-diabetics, hepatoprotectives, immunomodulators, nutraceuticals, natural products for gynecological disorders, anti-cancer, anti-viral (mainly anti-HIV), adaptogens etc. Phytochemistry of Neem: General chemical class and identification tests, specific tests for markers, special reference to alkaloids (nimbin, nimbolide etc.), Phytochemistry of Brahmi: General chemical class and identification tests, specific tests for markers, special reference to bitters (bacosides)

Phytochemistry of Turmeric: General chemical class and identification tests, specific tests for markers, special reference to phenols (curcuminoids), Phytochemistry of *Withania somnifera*: General chemical class and identification tests, specific tests for markers, special reference to steroids (withanolides), Phytochemistry of *Andrographis paniculata*: General chemical class and identification tests, specific tests for markers, special reference to bitters (andrographolides), Phytochemistry of Ginger: General chemical class and identification tests, specific tests for markers, special reference to phenols (gingerols), Phytochemistry of Garlic: General chemical class and identification tests, specific tests for markers, special

reference to phenols (allicin), Phytochemistry of *Terminalia Arjuna*: General chemical class and identification tests, specific tests for markers, special reference to triterpenes (arjunolic acid)

Suggested Readings

E-content: www.nmpb.nic.in/

Textbook of Pharmacognosy and Phytochemistry Jarald, Edwin E. and Edwin JaraldSheeja

Textbook of Industrial Pharmacognosy, Kalia, A.N

Pharmacognosy and Pharmaco biotechnology Ashutosh Kar

Trease and Evans Pharmacognosy, Evans, W.C.

Pharmacognosy Kokate, C.K A and Purohit, A.P

CCCH0202 Phytochemistry Laboratory Credits:3 (0+3)

Practical

Preparation of extracts of Herbs by successive solvent extraction method to record the percentage yield. Detection of Phytoconstituents such as i) Alkaloids, ii) Steroids, Triterpenoids and their glycosides and Saponins iii) Flavonoids and their glycosides iv) Anthracene Glycosides v) Coumarins vi) Tannins by chemical tests and TLC methods. Extraction and estimation of volatile oils by Clevenger's method (Hydro distillation method). Isolation and Purification of following natural products, (a)Piperine from Black Pepper, (b)Caffeine from Tea Powder, (c) Eugenol from Clove oil. Isolation of natural products by column chromatography. TLC figure print profiles of following medicinal plants with special emphasis on their marker compounds, (a) *Withania somnifera*, (b) *Bacopa monnieri*, (c) *Curcuma longa*, (d) *Glycyrrhiza glabra*

Suggested Readings

Natural Products: A laboratory guide by Raphael Ikan, Academic Press.

Pharmacognosy by C.K. Kokate , Publisher: Nirali Prakashan

Pharmacognosy by Trease & Evans

Pharmacognosy & Phytochemistry by Vinod Rangari

Chemistry of Natural Products: A Laboratory Handbook by Krishnaswamy NR.

CCAY0105 Regulations & Certifications of Herbal Drugs Credits: 3(3+0)

Theory

Licensing authorities, Licences for herbal products E.g.: Ayurveda, Proprietary medicine, consumer care etc., Manufacturing licenses and its importance, Manufacturing practices and its importance. FSSAI introduction, categories under FSSAI in detail, Ingredients (herbal and non-herbal) and its limits as per FSSAI, Licensing as per FSSAI, CDSCO and its role in clinical trials, Types of clinical trials, Claim substantiation and documentation.

CCAY0106 Material Science of Excipients and Additives Credits: 3(3+0)

Theory

Preformulating Studies - Introduction to preformulating, goals and objectives, study of physicochemical characteristics of drug substances. Physical properties: Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism. Chemical Properties - Hydrolysis, oxidation, reduction, racemization, polymerization BCS classification of drugs & its significance. Application of pre-formulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms. Tablets - Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipment's and tablet tooling. Tablet coating - Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating. c. Quality control tests: In process and finished product tests. Liquid orals - Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging - Evaluation of liquid orals official in pharmacopoeia. Capsules, Hard gelatin capsules - Introduction, Production of hard gelatin capsule shells. size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules. Soft gelatin capsules - Nature of shell and capsule content, size of capsules, importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications. Pellets: Introduction, formulation requirements, palletization process, equipment's for manufacture of pellets. Parenteral Products - Definition, types, advantages and limitations. Pre-formulation factors and essential requirements, vehicles, additives, importance of isotonicity

Suggested Readings

Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman & J.B. Schwartz

Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman

Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman
 Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition
 Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)
 Theory and Practice of Industrial Pharmacy by Liberman & Lachman
 Pharmaceutics- The science of dosage form design by M.E.Aulton, Churchill livingstone, Latest edition
 Introduction to Pharmaceutical Dosage Forms by H. C. Ansel, Lea & Febiger, Philadelphia, 5th edition, 2005
 Drug stability - Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition, Marcel Dekker Series, Vol 107.

CCCM0201 Pharmacology Credits:3(2+1)

Introduction, Definition & scope of Pharmacology and Principles of general Pharmacology, Brief Knowledge of following - CNS depressants, Sedatives, Antipyretics, Analgesics Antiepileptic, Antihypertensive, Anticoagulant, Haemopoetic, Bronchodilators, Expectorants, Digestants, Antacids, Laxatives, Diuretic, Antidiabetic, steroids, Contraceptives, Antibiotics. • Route of Drug Administration, Aoushadha Suvan kala, Anupana- its importance, Posology.

Suggested Readings

Lippincott's illustrated reviews: Pharmacology (4th ed.). Philadelphia: Lippincott Williams & Wilkins.
 Katzung, Bertram G., Susan B Masters, and Anthony J Trevor. *Basic & Clinical Pharmacology*.
 Rang and Dale's pharmacology" APA (6th ed.) Chicago (Author-Date, 15th ed

**DEMG0101 Interpersonal Skills, Entrepreneurship and Start up
 Credits:1(1+0)**

Theory

Entrepreneurship: General concept, Definition, Entrepreneurial, culture, Theory of entrepreneurship, Types of entrepreneurship, entrepreneurial trade and motivation, Entrepreneur and professional manager. Environment and entrepreneurial development: Entrepreneur environment, process of entrepreneurial Development, training of entrepreneur institutions, producing aids for an entrepreneurial development. Project Appraisal and

Management search for business ideas, project identification and formulations, project appraisal, Profitability and risk analysis, and Sources of finance, Role of consultancy organization. Legal and statutory Environment in setting of a small industry, Basics of vacancies Act, our job laws, government set up in promoting small financial institution, export - import rules. Location of an enterprise, Factory design and layout, Setting quality standard steps in starting a small industry, incentive and subsidies, Problems in small enterprise Management, Sickness and Preventions.

Suggested Readings

Dynamics of Entrepreneurial Development and Management, Vasanta Desai HPH
Entrepreneurship Development, Colombo Plan Staff College of Technical Education
(Adapted By Center for research and Industrial Staff Performance, Bhopal) Tata Mcgraw
Hill. New Delhi -1998.

BSRT2404 Human values and Professional Ethics Credits:1 (1+0)

Introduction to Ethics: What is the study of ethics, Introduction to Indian and Western Ethics, Different Ethical systems and Perspectives: Ethical relativism and its implications, utilitarianism, duty ethics and virtue ethics, Critique of various aspects of ethical positions: Critique and development of the ability to formulate own ethical position on an issue, Understanding and Conceptualizing Gender Relations, Gender Issues in Development Sectors, Gender Analysis, Tools, Techniques and Frameworks. Introduction to Human Rights, Human Rights Law: International Human Rights Law, Council of Human Rights, Universal Declaration of Human Rights, Legal Effects of the Declaration, International Humanitarian Law, Conflicts of Rights and Future Challenges: Meaning and Definition, History, Principles, Characteristics, Types.

Suggested Readings

Arihants UGC NET Human Rights and Duties.

Kapoor, S. K. Central Law Agency's Human Rights under International Law and National Law.

Freedman, Jane. (2002), "Introduction: Feminism or Feminisms?" in *Feminism*, Viva Books, N. Delhi.

Chafetz, J.S. (1990), "The Coercive Bases of Gender Inequality", in *Gender Equity: An Integrated Theory of Stability and Change*, Sage.

Semester IV

CCPY0101 Pharmaceutical Technology-I Credits: 3(3+0)

Theory

Solution: Formulation, aqueous and non-aqueous vehicles, factors affecting rate of solubilization and solubility, methods to improve aqueous solubility, formulation additives; Elixirs; Linctus; Mouthwashes and Gargles; Nasal and Ear drops; Lotions; Stability of solution; Syrups. Suspension: Theoretical consideration, preparation, evaluation, stability.

Powder: Classification, advantages of powder formulation, milling, mixing and dividing of powders, factors influencing blending of powders, powders containing liquids. Pharmaceutical calculations. Labelling of Pharmaceutical products. Emulsions: Definition, type of emulsion, theories of emulsification, pharmaceutical applications, preparation, stability and preservation.

Ointments: Classification, ointment bases, preparation and evaluation. Paste: Bases of paste, preparation of paste. Jelly: Type of jelly, jellying agents and their properties, preparation of jellies. Lozenges: Definition and preparation. Suppositories: Bases, method of preparation, quality control

Suggested Readings

Ansel H C, Introduction to Pharmaceutical Dosage Forms, K M Varghese & Co., Bombay.

Aulton M E Pharmaceutics - The Science of Dosage Form Design, ELBS/ Churchill Livingstone.

Avis K E, Lachman L and Lieberman H A, Marcel Dekker Inc. Pharmaceutical Dosage Forms; Parenteral Medications, Vols. 1& 2, NY.

Badger W L and Banchemo J T, Introduction to Chemical Engineering McGraw Hill Intematonal Book Co., London.

Banker G S and Rhode C T Modem Pharmaceutics, Marcel Dekker Inc., NY.

Bean H S, Beckett A H, and Carless A H Advances in Pharmaceutical Sciences, Vol 1-4 Academic Press, London.

CCPY0202 Pharmaceutical Technology-I Laboratory Credits:3(0+3)

Preparation and evaluation of Magnesium Citrate Oral Solution USP, Preparation and evaluation of Aqueous Iodine Solution IP, Preparation and evaluation of Tincture of Iodine, Preparation and evaluation of Cresol with Soap Solution IP, Preparation and evaluation of Surgical Chlorinated Soda Solution, Preparation and evaluation of Oral rehydration salt, Preparation and evaluation of talcum powder, Preparation and evaluation of tooth powder,

Preparation and evaluation of Milk of magnesia Suspension, Preparation and evaluation of Mouth wash, Preparation and evaluation of Calamine lotion, Preparation and evaluation of Liquid paraffin emulsion.

Suggested Readings

L V Allen, N G Popovich, H C Ansel, Ansel's Pharmaceutical dosage forms & Drug Delivery Systems, 9th edition, 2nd Indian reprint, 2011, Published by Lippincott Williams and Wilkins, Wolters Kluwer (India) Pvt. Ltd., New Delhi.

M E Aulton, K Taylor, Pharmaceutics: The Science of Dosage Form Design, 2nd edition. Edited by M E Aulton, Published by Churchill Livingstone, 2001.

Remington: The Science and Practice of Pharmacy, Volumes 1-2, 22nd edition, 2012, Edited by Allen L V, Adeboye A, Shane P D, Linda A F, Jointly published by Pharmaceutical Press and Philadelphia College of Pharmacy at University of the Sciences.

Leon Lachman, Herbert A. Lieberman, Joseph L. Kanig, The Theory and Practice of Industrial Pharmacy. 3rd edition, 1986, CBS publishers and Distributors, New Delhi.

CCCM0102 Advanced Extraction Technologies Credits:3(3+0)

Introduction to extraction of Medicinal Plants-General Methods of Extraction -Steps Involved in the Extraction-Maceration, Percolation and Infusion Techniques for the Extraction-Decoction and Hot Continuous Extraction Techniques. Selecting an appropriate extraction method, Extraction methods for Essential Oil-Counter-current Extraction-Aqueous Alcoholic Extraction by Fermentation- Microwave assisted Extraction- Pressurized extraction techniques. Enzyme extraction, Molecular Distillation. Supercritical Fluid Extraction-Ultrasound Extraction (Sonication) - Subcritical Fluid Extraction Green Extraction-Phytonics Process-Extraction Process Design and Optimization Using Design of Experimental Approach (DOE).

Suggested Readings

Essentials of Botanical Extraction-Principles and Applications: by Mandal SC et al., 2015, Elsevier Inc

Extraction technologies for medicinal and aromatic plants, International centre for science and high technology. Edited by Sukhdev Swami Handa, Suman Preet Singh Khanuja, Gennaro Longo, Dev Dutt Rakesh., 2008, ICS-UNIDO.

CCCM0203 Advanced Extraction Laboratory Credits: 3(0+3)

Practical

1. Super Critical Fluid Extraction of below listed herbs
 - a. Pepper
 - b. Turmeric
2. Separation of essential oil by SCF technique
 - a. Clove oil
 - b. Zinger oil
3. Preparation of water extract of Amla fruit by Microwave assisted extraction.

Suggested Readings

Essentials of Botanical Extraction-Principles and Applications: by Mandal SC et al., 2015, Elsevier Inc

CCMA0101 Statistical Quality Control & Production Management Credits: 3(3+0)

Theory

The Meaning of Quality and Quality Improvement - Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management (quality philosophy, links between quality and productivity, quality costs, legal aspects of quality implementing, quality improvement). Modeling Process Quality - Mean, Median, Mode, Standard deviation, calculating area, The Deming funnel experiment, Normal distribution tables, Finding the Z score, Central limit theorem. Methods and Philosophy of Statistical Process Control - Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length-ARL). Control Charts for Variables - Control Charts for X-Bar and R- Charts, Type I and Type II errors, the probability of Type II error. Simple Numerical Problems. The foundation of process capability, Natural Tolerance limits, cp – process capability index, cpk, pp – process performance index, summary of process measures. Numerical problems. Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, Control Charts for Nonconformities or Defects, Control Chart for Number of non-conformities per unit. Numerical problems. The acceptance sampling problem, single sampling plan for attributes, Double, Multiple, and Sequential sampling, AOQL, LTPD, OC curves, Military Standard 105E, the Dodge-Romig sampling plans. Numerical problems.

Suggested Readings

Douglas.C. Montgomery, “Introduction to Statistical quality control”, 4th edition, John Wiley 2001.

John.S. Oakland. “Statistical process control”, 5th edition, Elsevier, 2005

Connor, P.D.T.O., “Practical Reliability Engineering”, John Wiley, 1993

Grant, Eugene .L “Statistical Quality Control”, McGraw-Hill, 1996

Monohar Mahajan, “Statistical Quality Control”, Dhanpat Rai & Sons, 2001.

Gupta. R.C, “Statistical Quality control”, Khanna Publishers, 1997.

Besterfield D.H., “Quality Control”, Prentice Hall, 1993.

Sharma S.C., “Inspection Quality Control and Reliability”, Khanna Publishers, 1998.

CCMA0101 Design of Experiments Credits:3(3+0)

Theory

Strategy of Experimentation, Typical applications of Experimental design, Basic Principles, Guidelines for Designing Experiments. Concepts of random variable, probability, density function cumulative distribution function. Sample and population, Measure of Central tendency; Mean median and mode, Measures of Variability, Concept of confidence level. Statistical Distributions: Normal, Log Normal & Weibull distributions. Hypothesis testing, Probability plots, choice of sample size. Illustration through Numerical examples. Classical Experiments: Factorial Experiments: Terminology: factors, levels, interactions, treatment combination, randomization, Two-level experimental designs for two factors and three factors. Three-level experimental designs for two factors and three factors, Factor effects, Factor interactions, Fractional factorial design, Saturated Designs, Central composite designs. Illustration through Numerical examples. Measures of variability, Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments: YATE’s algorithm for ANOVA, Regression analysis, Mathematical models from experimental data. Illustration through Numerical examples. Quality, Western and Taguchi’s quality philosophy, elements of cost, Noise factors causes of variation. Quadratic loss function & variations of quadratic loss function. Robust Design: Steps in Robust Design: Parameter design and Tolerance Design. Reliability Improvement through experiments, Illustration through Numerical examples. Evaluation of sensitivity to noise. Signal to Noise ratios for static problems: Smaller-the-better type, Nominal-the –better-type, Larger-the-better type. Signal to Noise ratios for Dynamic problems. Illustration through Numerical examples.

Suggested Readings

Design and Analysis of Experiments, Douglas C. Montgomery, 5th Edition Wiley India Pvt. Ltd. 2007
Quality Engineering using Robust Design, Madhav S. Phadke, Prentice Hall PTR, Englewood Cliffs, New Jersey 07632, 1989.

Quality by Experimental Design, Thomas B. Barker, Marcel Dekker, Inc ASQC Quality Press. 1985.

Experiments Planning, analysis, and parameter Design optimization, C.F. Jeff Wu Michael Hamada, John Wiley Editions. 2002.

Reliability Improvement by Experiments, W.L. Condra, Marcel Dekker, Inc ASQC Quality Press. 1985.

SEMESTER V

CCPY0103 Pharmaceutical Technology-II Credits:3(3+0)

Theory

Tablet: Definition, types, additives; Methods of preparation; Processing problems, evaluation, commercial processing equipment's, other compressed tablets, flow design for tablet manufacturing. **Tablet coating:** Sugar coating process, characteristics and requirements of uncoated tablet, equipment's, film coating process-materials, solvents, and additives for film coating, air suspension coating and dip coating, film testing's and film defects, electrostatic coating, laminated coating, physiological availability. **Capsules:** Manufacturing area design, lay-out and flow diagram of capsule manufacture; hard gelatine capsule; materials for capsule; method of capsule shell production; capsule filling equipment's; capsule filling operations; soft gelatine capsule; Size and shape, methods of manufacture; nature of capsule shell and capsule content, and evaluation.

Suggested Readings

Ansel H C, Introduction to Pharmaceutical Dosage Forms, K M Varghese & Co., Bombay.

Aulton M E Pharmaceutics - The Science of Dosage Form Design, ELBS/ Churchill Livingstone.

Avis K E, Lachman L and Lieberman H A, Marcel Dekker Inc. Pharmaceutical Dosage Forms; Parenteral Medications, Vols. 1& 2, NY.

Badger W L and Banchemo J T, Introduction to Chemical Engineering McGraw Hill International Book Co., London.

Banker G S and Rhode C T Modern Pharmaceutics, Marcel Dekker Inc., NY.

Bean H S, Beckett A H, and Carless A H Advances in Pharmaceutical Sciences, Vol 1-4 Academic Press, London.

CCPY0204 Pharmaceutical Technology-II Laboratory Credits: 3(0+3)

Practical

Preparation of absorbable dusting powder, Size reduction of camphor crystalline powder by Pulverization by Intervention method, Determination of Angle of Repose of Powders, Determine the bulk density, porosity of 10 gm of the supplied powders A and B. Provided that, the true densities of powders are 2.75 and 3.18 respectively. Tabulate your results. Determine the percent compressibility of 10 gm of magnesium sulphate powder by calculating the tapped and bulk density. Tabulate your results. Send 20 gm of effervescent granules Sod. Citrotartarate. To prepare and compress 30 tablets each contains 0.9 g sodium chloride by direct compression method. To prepare and compress 20 tablets each contains sodium bicarbonate by wet granulation method. Preparation and purification of disodium edetate and estimations of Calcium lactate Tablet I.P./ Calcium gluconate I.P., Evaluation of tablets. Evaluation of capsule dosage forms (B.P)

Suggested Readings

Vogel's Text Book of Quantitative Chemical Analysis, 6/Ed., Pearson Education.

Quantitative analysis by V. Alexyev, Student Edition, CBS Publisher & Distributors.

Fundamentals of Analytical Chemistry by Skoog, West, Holler, Harvest, 8/Ed., Thomson Brookscole.

Pharmaceutical Analysis by Higuchi, Reprint 2004, CBS Publisher & Distributors.

The quantitative analysis of drugs by Garrat DC, 3/Ed., CBS Publisher & Distributors.

Quantitative Analysis by Day R A & Underwood A L. 5/Ed., Prentice Hall of India Pvt. Ltd. New Delhi.

Analytical Chemistry by Christian G D, 6/Ed., John Wiley & Sons.

A Textbook of Pharmaceutical Analysis by Connors KA, 4/ed., John Wiley & Sons.

Practical Pharmaceutical Chemistry Part-I by Beckett A H & Stanlake J B, 4/Ed., CBS Publisher & Distributors.

Pharmaceutical Analysis Vol. II & K. R. Mahadik, S.G. Wadodkar, H. N, More, NiraliPrakashan.

Pharmaceutical Drug Analysis by Ashutosh Kar, First Print, 2001, Minerva Press, NewDelhi.

Indian Pharmacopoeia, 6th Edition, 2010, The Indian Pharmacopoeia Commission, Ghaziabad.

CCAY0107 Analytical Instrumentation for Herbal Products Credits:3(3+0)

Theory

Planer chromatography–TLC/HPTLC/OPLC: Basic principles, sample application, development of plates, visualization of plates, 2D TLC, densitometry, over pressure layer chromatography. High Pressure Liquid Chromatography (HPLC): Principles, instrumentation, peak shapes, capacity factor, selectivity, plate number, plate height, resolution, band broadening, pumps, injector, detectors, columns, column problems, gradient HPLC, HPLC solvents, trouble shooting, sample preparation, method development. Gas chromatography: principles, instrumentation, split-splitless injector, head space sampling, columns for GC, detectors, quantification. Bio-chromatography: Size exclusion chromatography, ion exchange chromatography, ion pair chromatography, affinity chromatography general principles, stationary phases and mobile phases. **Ultraviolet and Visible Spectroscopy:** Electronic transitions (185-800 nm), Beer- Lambert Law, Effect of solvent on electronic transitions, Ultraviolet bands of carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, Ultra- Violet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls. Applications of UV-visible spectroscopy in organic chemistry. **Infrared Spectroscopy:** Instrumentation and sample handling, Characteristic vibrational frequencies of common organic compounds. Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance. **NMR Spectroscopy:** Fundamentals of the NMR phenomenon, relationship between NMR spectra and molecular structure. Recording of routine spectra (^1H and ^{13}C), essentials of data processing (e.g., weighting functions). 1D NMR techniques: Decoupling, DEPT, relaxation measurement, magnetisation transfer, NOE difference spectra. 2D NMR techniques: Homo- and heteronuclear correlation (COSY, TOCSY, HSQC, HMBC), measurement of the nuclear Overhauser effect (NOESY, ROESY). Emphasis is on learning the practical use of NMR equipment. **Mass spectrometry:** Basic principles, ionization techniques, isotope abundance,

molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution MS, soft ionization methods, ESI-MS, LC-MS and MALDI-MS, illustrative examples from macromolecules and supramolecules.

Suggested Readings

Introduction to Spectroscopy: A Guide for Students of Organic Chemistry, Donald L. Pavia, Gary M. Lamlma and George S. Kriz, Thomson

Spectroscopy of Organic Compounds, 6th edition, P. S. Kalsi, New Age International United Publication

Instrumental Methods of Analysis, 7th edition, Hobart H. Willard, Lynne L. Merrit, John A., Dean and Frank A. Settle, CBS Publishers

Spectrometric Identification of Organic Compounds, 6th edition, Robert M. Silverstein and, Webster Fransis, Wiley-VCH

CCAY208 Analytical Instrumentation for Herbal Products Laboratory

Credits: 3(0+3)

Practical

Extraction and isolation of piperine from *Piper longum* fruits, Extraction and isolation of curcumin from *Curcuma longa* rhizomes, Bioactivity guided fractionation (Concept building), Preparation of sequential extracts by Maceration/Soxhlet/ASE, Characterization of given glycoside/terpenoids using TLC, HPLC analysis of extracts, Standardization of Herbal Extracts & commercial products, De-replication of natural products, Gel permeation /Ion-exchange/HILIC/Normal phase chromatography for bio-molecules (proteins/carbohydrates etc.), Mass spectrometric analysis of small molecules, Mass spectrometric analysis of vitamins in biological fluids

Suggested Readings

Applied Thin Layer Chromatography, 2nd edition, Elke Hahn Deinstrop Wiley-VCH

HPLC Made to Measure: A Practical Handbook for Optimization Stavros Kromidas, Wiley-VCH

Thin Layer Chromatography: A Modern Practical Approach Practical HPLC method development Lloyd R. Snyder, Joseph J. Kirkland and Joseph L. Glajch John Wiley and Sons.

FCIP0101

IPR and Applications

Credits:2(2+0)

Theory

Overview of Intellectual Property- Introduction to intellectual property right (IPR), Kinds of Intellectual Property Rights, International Instruments concerning Intellectual Property Rights- Paris Convention 1883, the Berne Convention 1886, the Universal Copyright Convention, 1952, the WIPO Convention 1967, the Patent Co-operation Treaty 1970, the TRIPS Agreement 1994, India's National Intellectual Property Rights (IPR) Policy 2016.

Patents - Elements of Patentability: Novelty, Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board.

Trademarks- Concept of Trademarks, Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks), Non Registrable Trademarks, Registration of Trademarks, Rights of holder and assignment and licensing of marks, Infringement, Remedies & Penalties, Trademarks registry and appellate board.

Other Forms of IP- Copyrights, Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings; Design: meaning and concept of novel and original, Geographical indication: meaning, and difference between GI and trademarks, Plant variety protection: meaning and benefit sharing and farmers' rights.

Suggested Reading

Chawla, H.S. (2017). Introduction to Intellectual Property Rights Oxford & Ibh.

Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.

Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.

WIPO Intellectual property Handbook.

https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf

Cell for IPR Promotion and Management (<http://cipam.gov.in/>)

World Intellectual Property Organisation (<https://www.wipo.int/about-ip/en/>)

Office of the Controller General of Patents, Designs & Trademarks
(<http://www.ipindia.nic.in/>)

CCCM0104 Packaging Technologies Credits:3(3+0)

Theory

Fundamentals of packaging - Definition, functions of packaging, types and selection of package, Packaging hazards, interaction of package and contents, materials and machine

interface, Environmental and recycling considerations – life cycle assessment Package Design – Fundamentals, factors influencing design, stages in package development. **Packaging materials** - Major Plastic packaging materials viz. Polyolefins, Polystyrene, Polyvinylchloride, Polyesters, Polyamides (Nylons), Polycarbonate and newer materials such as High Nitrile Polymers, Polyethylene Napthalate (PEN), Nanomaterials, biodegradable materials – properties and applications, recycling; Wood, Paper, Textile, Glass, Metals – Tin, Steel, aluminum, Labelling materials, Cushioning Materials – properties and areas of application. **Conversion technology** - Extrusion – Blown film, cast film, sheet, multilayer film & sheet, Lamination, Injection molding, Blow molding, Thermoforming; Carton Machinery, Bottling, Can former, Form Fill and Seal machines, Corrugated box manufacturing machineries, Drums – types of drums, molded pulp containers, Closures, Application of Robotics in packaging. Surface treatment for printing, Printing processes – offset, flexo, gravure and pad printing. **Specialty packaging** - Aerosol packaging, Shrink and Stretch wrapping, Blister packaging, Anti-static packaging, Aseptic packaging, Active packaging, Modified Atmospheric Packaging, Openable package; Cosmetic packaging, Hardware packaging, Textile packaging, Food packaging; Child resistant and Health care packaging, Export packaging, Lidding, RFID in packaging. **Testing** - Package Testing – Drop test, Impact test, Vibration Test, Stacking and Compression test, Packaging Materials Testing: Mechanical – Tensile, tear burst, impact, compression test, Elongation, barrier properties – WVTR test, Adhesion test, Optical – Gloss, haze and clarity; Chemical Resistance test – solvents and chemicals, solubility test, burning test, solvent retention; Hardness and corrosion test for metals; Clarity and brittleness test for glass.

Suggested Readings

- Paine. F.A., “Fundamentals of Packaging”, Brookside Press Ltd., London, 1990.
- Athayle. A.S., “Plastics in Flexible Packaging”, Multi-tech Publishing Co., First Edition, 1992.
- Mark J.Kirwar, “Paper and Paperboard Packaging Technology”, Blackwell Publishing, 2005
- “Handbook of Package Design Research”, Water stem Wiley Intrascience, 1981.
- Paine, “Packaging Development”, PIRA International, 1990.
- Arthur Hirsch, “Flexible Food Packaging”, Van Nostor and Reinhold, New York, 1991.
- Danger. E.P., “Selecting Colour for Packaging”, Grover Technical Press, 1987.
- Susan E.M.Salke& et al, Plastics Packaging, Hansar, 2nd edition 2004.
- Bill Stewart, “Packaging Design Strategies”, Pira International Ltd, 2nd Edition 2004.

Gunilla Johnson, "Corrugated Board Packaging", PIRA International, 1993.

SEMESTER VI

CCAY0109 Herbal Cosmetic Technology Credits:3(3+0)

Theory

Introduction to cosmetics- Skin, Hair and Nail Structure & function-Botanicals in Cosmetics -Cosmetics Ingredients & Nomenclature-Emulsions-Creams & Lotions-Face washes & Face Masks-Shaving Preparations-Sunscreens- Antiperspirant and Deodorants. Make-up preparations - Eye area makeup -Lip care preparations-Nail Preparations-Soaps -Bath & Shower Products-Shampoo & Hair conditioner's-Hair Oils & Hair Sprays-Toothpastes & Mouthwashes-Gels in Hair & Skin Care products. Fragrances-Toxicology in Cosmetics-Rheology fundamentals and application in cosmetic formulations-Claims support: Principles and Practice-Cosmetic product Packaging-Consumer testing & Evaluation

Suggested Readings

Handbook of Cosmetic Science and Technology –edited by Andre O. Barel et al., Publisher: Informa Healthcare.

The Chemistry and Manufacture of Cosmetics-edited by Mitchell L. Schlossman, Allured Publishing Corporation.

Harry's Cosmeticology – edited by Meyer R. Rosen

Textbook of Herbal Cosmetics Paperback -by Vimaladevi M.

Herbal Cosmetics Handbook- by H Panda

International Cosmetic Ingredient Dictionary & Handbook- by The Personal Care Products Council.

CCIB0101 Measurement Analysis Credits:3(3+0)

Theory

Classification of analytical methods. Characteristics of analytical methods, idioms in analytical process. Quality control of analytical methods, control of faults. Introduction of spectroscopy methods- spectroscopy, electromagnetic rays, absorption and emission of radiation, spectra, terms, types of instruments. Atomic Spectrometry- Atomic absorption spectrometry (AAS)- principle, appliance in pharmaceutical analysis, interference in AAS. Atomic emission spectroscopy (AES)- principle, instruments, applications, interference in AES analysis. Inductively coupled plasma (ICP)- principle, application, in pharmaceutical analysis, characteristics. Luminescent spectroscopy – Theory of phosphorescent and

fluorescent ion. Excited states on which phosphorescent and fluorescences are based. Emission and excitation spectra. Instruments. Application. Ultraviolet and visible spectroscopy (UV/VIS)- UV/VIS radiation, absorption. Lambert-Beer formula and its limitations, UV spectra, chromophores, instruments, qualitative and quantitative analysis. 6. Infrared spectroscopy (IR)- principle, molecule vibrations, spectra, interpretation, absorption-factors which influence absorption, instruments, preparation of the samples. Applications, examples of molecule spectra of pharmaceuticals. 7. Mass spectroscopy- theory of molecule mass spectroscopy, molecule fragmentation, homiletical and heterolytically α -disunion. Instruments, ionization techniques, EI, PICI, NICI. Ions in spectra, isotopic peaks, transfer of protons. Application, mass spectra of some pharmaceuticals. 8. Nuclear magnetic resonance (NMR)- Theory of nuclear magnetic resonance. Types of NMR spectra. NMR instruments. Applications. 9. Chromatography- introduction to chromatography techniques, classification of chromatography methods. Theory of chromatography, parameters, (indexing ratio, selectivity factor, resolution factor, number of theoretical plates). Principle of the separation, Rf value, applications. Thin layer chromatography (TLC)- purpose of TLC, stationary and mobile phases, ways of detections. Applications, examples. High performance thin layer chromatography (HPTLC)- principle, applications. High performance liquid chromatography (HPLC)- purpose of HPLC, instruments, principle. Partition, adsorption, ion-exchange and size elution chromatography. Stationary phase, types of interaction, normal and reversed phased chromatography systems. Mobile phase, isocratic and gradient elution. Influence of polarity, lipofility and pH values on elution. Qualitative and quantitative analysis, applications.

Gas chromatography (GC)- principle of gas chromatography, instruments. Types of columns and stationary phases. Selectivity of liquid stationary phase, retention index, system. Kovatzh index. Joining of the gas chromatography with spectroscopy methods. Cappillary electrophoresis (CE)- principle of electrophoretic separation. Instruments. Applications of CE in pharmaceutical analysis. High performance cappillary electrophoresis (HPCE). Preparation of the samples. Liquid-liquid extraction, principle, applications. Solid phase extraction (SPE), types of adsorbents, methodology, application. Electroanalytical chemistry- Introduction to electroanalytical chemistry, electrochemical cell, potential in electrochemical cell, electrode potential, current in electrochemical cell. Types of electrodes. Potentiometry. Direct potentiometry measurements, potential titrations. Introduction to voltammetry.

Suggested Reading

Principles of instrumental analysis 6th Ed., D.A. Skoog, F.J. Holler & S.R. Crouch, (2007)

Modern Chemical Analysis and Instrumentation , H. F. Walton & J. Reyes, (1980)
Standard Methods of Chemical Analysis, 6th Ed., volume 3, part A, F. J. Welcher, D. Van Nostrand Company, Inc., Princeton
Quantitative Analysis, 4th. Ed., Prentice-Hall, R. A. Day and Jr./A. L. Underwood, Inc., Newjersey, 1980
Vogel's Textbook of Quantitative Chemical Analysis, 5th. Ed. J. Bassell, R. C. Denney, G. H. Jeffery and J. Menham
Introduction to high performanceliquid chromatography R.J.Hamilton and P.A. Sewll, Liverpool polytechnic, London, John Willey & sons, NewYork, (1999).
Troubleshooting HPLC systems, A bench manual, P.C., Sadek, Ph.D, John Willey & sons, Inc. (2000).

Semester VII

CCAY0111 Downstream Processing of Phytopharmaceuticals Credits:3(3+0)

Theory

Downstream Processing - Introduction to downstream processing principles, Various downstream process steps, Fundamental principles of obtaining the product, Pre-treatment strategies, Solid-liquid separation, Crystallization, Drying. **Principles of solid-liquid separation processes** - Removal of insolubles and different methods used, Introduction to filtration, Continuous rotary filters, Problems related to filtration, Nutch filters, Sparkler filters, Filter press. Introduction to centrifugation, Types of centrifuges, Scale-up of centrifugation, Centrifugal filtration, Problems related to centrifugation, Decanters, Centrifugal separators. Different types of extractions, Aqueous two-phase extraction, Introduction to membrane separation techniques, Microfiltration, Ultrafiltration, reverse osmosis and problems. Basics of drying and its types, Tray Drying, Vacuum drying, Low temperature drying, Spray drying, Drum drying, Lyophilization, Spray freeze drying, Non-conventional drying methods, Problems in drying

Suggested Readings

P.A. Belter, E.L. Cussler And Wei-Houhu – Bioseparations – Downstream Processing For Biotechnology, Wiley Interscience Pub. (1988).

www.alfalaval.in

Potty V.H. and Mulky, M.J., Food Processing, Oxford and IBH (1993).

Heldman D.R. and Singh R.P., Food Process Engineering, Chapman and Hall (1984)

CCAY0212 Downstream Processing Laboratory Credits:3(0+3)

Practical Class on Size Reduction, particle size distribution, Practical Class Separation Techniques, Centrifugation, Practical Class on Membrane Separation Techniques, Practical Class on different Drying Techniques.

Suggested Reading

R.O. Jenkins, (Ed.) – Product Recovery In Bioprocess Technology – Biotechnology By Open Learning Series, Butterworth-Heinemann (1992).

FCCM0101 Heat and Mass Transfer Credits:3(0+3)

Introduction to Heat Transfer: Modes of heat transfer; Conduction – steady state heat conduction through uni-layer and multilayer plane wall sphere, cylinder; Insulation – types, critical radius, Optimum thickness of insulation. Forced and Natural convection; Significance of Dimensionless numbers (Nu, Gr, Pr, Re, Pe numbers only); Heat transfer without phase change, heat transfer in laminar and turbulent flow inside closed conducts, concepts of film heat transfer coefficients. **Heat Transfer Equipments:** Equations and numerical problem for calculations of film heat transfer coefficients, Heat transfer with phase change - Condensation – film wise and drop wise; Boiling – types of boiling. Co current and counter current flow. Individual and overall Heat transfer coefficients, LMTD, Elementary design of double pipe heat exchanger and shell and tube heat exchanger. **Basics of Mass Transfer:** Diffusion - Fick's law of diffusion. Measurement of diffusivity, Mass transfer coefficients and their correlations. Two film theory, Individual and Overall Mass Transfer Coefficients. **Distillation:** Vapour liquid equilibrium, T-xy, P-xy, x-y equilibrium diagram, Raoult's Law, Azeotropic mixtures, steam distillation. Numerical problems. **Mass Transfer operations:** Distillation –Methods of distillation –Simple, Flash distillation of binary mixtures – relative volatility, fractionation of binary mixtures -McCabe Thiele method, Extractive and Azeotropic distillation, numericals. **Other Mass Transfer operations:** Drying, Drying rate, Drying curve and calculations, Principles of: Extraction, Adsorption, and Absorption, Typical equipment's.

Suggested Reading

McCabe WL, Smith JC and Harriott (2005) Unit operations in Chemical Engineering, 7th Edn., McGraw-Hill Publications, USA

Treybal RE (2012) Mass Transfer Operations, 3rd Edition, McGraw-Hill Publications, USA.

Gavhane KA (2011) Unit Operations I & II, 25th Edn., Nirali Prakashan, India.

Badger, Banchero and Walter (1955). Introduction to Chemical Engineering, 3rd Edn., McGraw- Hill Publications, USA.

Alan S Foust, Wenzel LA, Clump CW, Maus L and Anderson LB (2008). Principles of Unit Operations, 2nd Edn., John Wiley & Sons, USA.

Coulson and Richardson's (2011). Chemical Engineering, Vols I & II, 6th Edn., Reed Educational and Professional Publishing Ltd., USA.

Kern (2001). Process Heat Transfer, 2nd Edn. McGraw-Hill Publications, USA.

Perry RH and Green DW (2008). Perry's Chemical Engineering Hand Book, 8th Edn., McGraw- Hill Publications.

Semester VIII

CCAY0313 Major Project Work Credits:17(14+3)

ELECTIVES

(A) QUALITY, REGULATORY & CERTIFICATIONS

DEAY0103 HACCP/HALAL/Organic Certifications/Fair Trade Credits: 2(2+0)

Theory

Organic certification- Purpose & Requirements-Global Organic regulatory bodies-National Organic Program (NOP)/USDA Organic-National Programme for Organic Production (NPOP)-ECOCERT- COSMOS. Non-GMO Project Product Verification Program-Kosher Certification-Hallal Certification-Hazard analysis and critical control points & ISO 22000. Fairtrade certification-Vegan Certification-Good Manufacturing Practice Certification (CGMP).

Suggested Reading

Essentials of Botanical Extraction-Principles and Applications: by Mandal SC et al., 2015, Elsevier Inc

Extraction technologies for medicinal and aromatic plants, International centre for science and high technology. Edited by Sukhdev Swami Handa, Suman Preet Singh Khanuja, Gennaro Longo, Dev Dutt Rakesh., 2008, ICS-UNIDO.

DEAG0101 Good Agriculture and Field Collection Practices Credits:2(2+0)

Theory

Definition, Background- Need for Good Agricultural and Collection Practices; GFPC; GAP; Documentation; Traceability; Personnel and Equipment's; Harvest and post-harvest management- Harvesting, Primary processing, Packaging; Storage and Transportation;

Training and Monitoring. Good Agricultural Practices: Seeds and propagation material- Seed, Stem & Root cuttings; Crop management for cultivation; Field preparation- Sowing and transplanting, Manures and fertilizers, Irrigation, Weeding and intercultural operations, and Crop protection; Good Field Collection Practices- Regulatory Requirements & Compliance - International, National and Local Regulations, Permission for collections; Field status- Gregariousness, Authenticity; Harvesting of Medicinal Plant Produce- Quality Considerations, Season of harvesting; Environmental Considerations, Social Considerations, Guidelines for collection and post-harvest management of various categories of medicinal plant produces

Suggested Readings

GACP guidelines of WHO

GACP guidelines of India

DEAY0104 Quality Assurance & Quality Control of Herbal Products Credits:2(2+0) Theory

Quality: Concept of quality, nature of product quality, study of various approaches for quality like Deming', Juran, Crosby, Feigenbaum, Shikaw. Quality income and cost. TQM awards and prizes. Quality benchmarking, details of international standards (ISO, GMP, GLP, TGM, VAN and ISI), its need and fact sheet evaluation (should include review or statistics of industries

implemented these standards with those which have not implemented these) Role of quality audit and quality circle in quality assurance. Quality assurance and GLP, implementing of GLP in non GLP analytical laboratory. Process management, project management, strategic development and product development. Measurement of quality, information and decision making or utilization of data. Quality operations, its inspection and test used for it.

Human resource and training for quality. Market survey, customer demand and marketing in addition to supplier and customer relationships. Quality, society and national culture.

Computerized system- software development, computer applications and quality system.

Requirements of product registration, in India and other countries (USA, UK, Japan and

Europe etc)., GLP, ISO 9000, TQM, Quality review and Quality Documentation. Application of process analytical technology (PAT) in quality assurance. Qualification validation and calibration of equipment. Analytical and bioanalytical method validation. Calibration and validation of various instruments used for drug analysis such as UV-Visible, Spectrophotometer, IR spectrophotometer, spectrofluorimeter, HPLC, HPTLC and GC.

Regulatory requirement in pharmaceutical analysis – US-FDA, ICH, PAC-ALTS: Post approval changes – analytical testing laboratory site etc. Analysis of drug from biological fluids

Application of analytical methods to product obtained through genetic engineering, Amino acid sequence analysis, tryptic mapping, ion exchange amino acid analysis, isoelectric focusing etc. Application of analytical methods to product obtained from natural sources (extracts, herbal formulations, isolated compounds, modern herbal formulations) (Compendial methods for evaluation of crude drug and herbal formulation), Dosage form impurity profile and its validation, Organization & personnel, responsibilities, training and records. Equipment selection, purchase specifications, maintenance, clean in place for analytical department, Premises - location, design, plant layout, construction maintenance and utilities and services like gas, water for analytical department, Introduction to pharmaceutical validation: definition, manufacturing process model, scope of validation, advantage of validation, organization for validation, validation of master plan, types of process validation, design qualification, installation qualification, operational qualification and performance qualification of facilities. Process validation: prospective, concurrent, retrospective and revalidation, Process validation of formulations like tablets, capsules, ointment/creams, liquid orals, sterile dosage form which should include following aspects

Personnel and organization

1. Raw materials

2. Equipments (e.g. Dry powder mixers, fluid bed and tray dryers, tablet
3. compression machine, capsule filling machines etc)
4. Area, premises and environment including storage of raw materials to finished
5. products
6. Water (validation of pharmaceutical water system and pure steam),

Packaging and labeling controls and its validation

Cleaning validation: cleaning of equipment, cleaning of facilities

Validation of Integrated lines by media fill test.

Validation of HVAC system

Vendor Certification. Validation of compressed air, validation of water and air handling systems, Validation of existing equipment and utilities validation, Computer system validation including installed softwares, Pharmaceutical development of drug substance and drug product, formulations, manufacture and supply of materials, labeling and presentation, stability and storage, purity, compatibility, disposal.

Suggested Readings

- K. Bansal, Chromatography, 1st Ed., Campus books, New Delhi, 2000.
- K. Bansal, Analytical spectroscopy, 1st Ed., Campus books, New Delhi, 2000.
- A. Kar, Pharmaceutical drug analysis, 1st Ed., Minerva books, New Delhi, 2001.
- S. Usharani, Analytical chemistry, 1st Ed., McMillan, New Delhi, 2000.
- D.H. Shah, SOP; Guidelines, 1st Ed., Business horizons, New Delhi, 1997.
- D.H. Shah, QA manual, 1st Ed., Business horizons, New Delhi, 1997
- A.H. Beckett, J.B.Stanlake, Practical Pharmaceutical chemistry-Vol- 1, 4th Ed., CBS, New Delhi, 2004.
- G.R. Chatwaal, Analytical spectroscopy, 1st, Himalaya publishing house, Mumbai, 1996.
- G.R. Chatwaal, Analytical chromatography, 1st, Himalaya publishing house, Mumbai, 1996.
- M. Parkany, Quality assurance and TQM for analytical laboratory, Royal society of chemistry, New Delhi, 1995

(B) MANUFACTURING & PRODUCTION PLANNING

DEMG0102 Production Planning & Inventory Control Credits:3(3+0)

Theory

Introduction to Production planning Control-Objectives of PPC-Functions of PPC-Organization of production planning and control department -Types of Production Planning System-Forecasting & Types of forecasting methods-Master Production Schedule & Process Operation Scheduling-Gantt Chart-Types of Scheduling Rules-Priority Sequence-Production Activity Control-Inventory management -Functions of inventories-Inventory related costs-Inventory Modelling (Economic Order Quantity (EOQ) Model, Economic Production Quantity (EPQ) Model)- Inventory control systems (P-Systems and Q-Systems), Introduction to MRP & ERP, LOB (Line of Balance)- Bill of material-Line Balancing, Aggregate planning, Chase planning, Expediting- Applications of computer in production planning and control.

Suggested Readings

Elements of Production Planning and Control -by Samuel Eilon, Universal Publishing Corp., 1999.

Modern Production / Operations Management – by Baffa & Rakesh Sarin, John Wiley & Sons, 2002.

DEMG0103 Supply Chain Management Credits:3(3+0)

Theory

Concept & scope of Supply Chain Management -Process of SCM-Demand Forecasting in a Supply Chain-Managing Demand and Supply in a Supply Chain-Aggregate Planning-Supply Chain Planning & Design-Logistics management in SCM-Inventory management in SCM and types of inventories. Transportation in SCM -Transportation-network design - Routing and Scheduling-Warehousing-Inbound SCM-Process of Sourcing; Supplier Selection & Procurement-Outbound SCM- Material Handling Principles-Retail Supply Chain Management- Distribution to stores-Distribution Channels-Cooperation and Coordination in Supply Chain. Role of Outsourcing in a Supply Chain-Measuring Supply Chain Performance-Information Technology in Supply Chain-E-Business and the Supply Chain-Green Supply Chains- Supply chain practices in India.

Suggested Readings

Supply Chain Management, Edited by PengzhongLi, Published by InTech 2011.

Foundations of Inventory Management. by Zipkin, P.H., McGraw-Hill, New York.2000

Hong, P.; Kwon, H. & Roh, J. J. (2009). Implementation of strategic green orientation in supply chain: An empirical study of manufacturing firms. European Journal of Innovation Management, Vol. 12, No. 4, pp. 512-532.

DEMG0104 Disaster Management and Industrial Safety Credits:3(3+0)

Theory

Disasters and their management - Introduction of disasters, Classification and sub types of disasters. Industrial disasters and related case studies. Role of safety officer in disaster management in industry. Economical impacts of natural disasters on industry and role of EHS officer. Developing OH and S policy– Guidelines – Developments - procedure - Content of OH and S policy – General principle, strategy and planning, specific goals, compliance – methodology. Planning – Guidelines, methodology steps developing action plan – Analysis and identify the priorities, objective and Targets, short term action plan, benefits and cost of each option, Development of action plan. Fire and Explosion - Chemistry of fire, Stage of fire, Factors contributing to fire, Classification of fire, Common cause of industrial fires. Fire prevention and protection system, Special safety precaution, Control of fire and explosion in handling / processing flammable liquids, gases, vapors, mists, dusts etc. Fire emergency action plan and control room. NFPA code and standard, on-site emergency plan, off-site emergency plan. Environmental Management System in Industry - Quality of environment. ISO 14000 Environment standards, EMS model. Policy planning process, implementation and operation in industry. Definition of pollution, pollutant and significance of pollution of pollution control. Types of environment pollution: air, water and land pollution and control. Hazardous waste management system - landfill as incineration, environment problems and solution Concept of Restoration Ecology and Reclamation of degraded land.

Suggested Readings

Heinrich H.W. “Industrial Accident Prevention” McGraw-Hill Company, New York, 1980.

Krishnan N.V. “Safety Management in Industry” Jaico Publishing House, Bombay,1997

Safety and Good House Keeping, N.P.C., New Delhi, 1985.

Accident Prevention Manual for Industrial Operations, N.S.C.Chicago, 1982.

DEMG0105 Good Manufacturing Practices-Herbal Industry Credits:3(3+0)

Theory

Guidelines for the manufacture of herbal medicines - Quality assurance in the manufacture of herbal medicines, Good manufacturing practice for herbal medicines, Airlock, Clean area, Critical operation, cross-contamination, Calibration, Pipe work, light fittings, ventilation points, other services like Sanitation and hygiene. Qualification - Contract production and analysis, Self-inspection, Personnel, Training, Personal hygiene, Premises, Equipment, Materials, Documentation, Batch number (or lot number), Batch records, In-process control, Intermediate product, Master formula, SOP, OCP, HIRA, Good practices in production, Packaging, Packaging material, Qualification, Good practices in quality control. Validation – Introduction, Basic concepts, types and stages of validation, validation master plan (VMP), equipment validation. Concept of URS, DQ, IQ, OQ & PQ and process-types. Prospective, concurrent and retrospective validation & revalidation. Quality assurance in Herbal Drug Industry concept of TQM, GLP, ISO-9000, Quality audit, Suppliers’ audits and approval, Auditing of Storage area, Weighing areas, Production area, Intermediate and bulk products and finished products, HACCP in traditional system of medicine.

Suggested Readings

Good Manufacturing Practices for pharmaceutical products. In: WHO Expert Committee on Specifications for Pharmaceutical Preparations. Twenty second report. Geneva, World Health Organization, 1992, Annex 1 (WHO Technical Report Series, No. 823).

Validation of analytical procedures used in the examination of pharmaceutical materials. In: WHO Expert Committee on Specifications for Pharmaceutical Preparations. Thirty-second report.

Geneva, World Health Organization, 1992, Annex 5 (WHO Technical Report Series, No. 823). General guidelines for methodologies on research and evaluation of traditional medicine.

Geneva, World Health Organization, 2000. 6. Quality control methods for medicinal plant materials. Geneva, World Health Organization, 1998.

DEMG0106 Sustainable Manufacturing Practices Credits:3(3+0)

Introduction - Concept of sustainability, manufacturing, operations, processes, practices. Resources in manufacturing, five Ms, system approach to manufacturing. Basic experimental design, factor identification, quantification, comparison, selection Introduction to simulation modeling and analysis. Overview of modeling and decision making, modeling pitfalls, good modeling practices

Simulation models for manufacturing, validation, verification, output analysis Concepts of optimization, numerical optimization through simulation Approaches for process factors optimization,

ABC algorithm Life Cycle Analysis: product life cycles, life cycle of a manufacturing system. Life Cycle Analysis: reduce, reuse, recycle; waste vs value approach

Life Cycle Analysis: remanufacture and disposal , tools for LCA. Optimization for achieving sustainability in unit manufacturing. Green manufacturing Lean models, value analysis, carbon footprint, analysis for carbon footprint Green manufacturing: sustainability framework Green manufacturing techniques: factors effecting sustainability

Implementation of lean methods: validating requirements Green Supply chain: Carbon footprints in transportation Green Supply chain: techniques and implementation Green Supply chain: Logistics management Green Supply Chain as Product Life Cycle Management

Product Life Cycle Management: Energy and Mass Product Life Cycle Management: Workpool and Throughput Eco-efficiency and eco-effectiveness for cleaner production Social aspects of Sustainable manufacturing Social aspects of Sustainable manufacturing: Long term and short term goals

Modern approaches for Sustainable Manufacturing Toxic substances in industry, and need of Renewable sources Renewable Sources of Energy Renewable Sources of Energy (continued.) Industry Symbioses for reducing Carbon footprint

Modern approaches for Sustainable Manufacturing Toxic substances in industry, and need of Renewable sources Renewable Sources of Energy Renewable Sources of Energy (continued.) Industry Symbioses for reducing Carbon footprint

Suggested Readings

Klimes, J., 2011. Sustainability in the process industry. McGraw-Hill.

Seliger, G., Khraisheh, M.M. and Jawahir, I.S. eds., 2011. Advances in sustainable manufacturing. Springer Science & Business Media.

Dornfeld, D.A. ed., 2012. Green manufacturing: fundamentals and applications. Springer Science & Business Media.

DEMG0107 Employee Relations & Training Credits:3(3+0)

Theory

Industrial relations in historical context: development of IR system in India, Labour management relations: trade unionism, collective bargaining, employee grievances, employee discipline, industrial conflict, labour welfare and social security. Workers participation in management, India and International labour standards, Judicial activism, alignment, labour policy and industrialization, strategies, New paradigms of industrial relations.

Training and development an overview. Training objective and significance in organizations. Knowledge, skills and attitudes Acquiring Competencies via training route. Training Need Assessment. The rationale of conducting a TNA. When to conduct TNA. The process of conducting TNA. A three-stage approach. The importance of setting objectives. Facilitation of Learning: Focus on Trainee. Facilitation of learning: Focus on Training design. Facilitation of Transfer: Focus on Training. Facilitation of Transfer: Focus on Organizational Intervention. Design outcomes. Design theories Gagne –Briggs Theory. Training methodology On the Job training Off the job Training Methodology. Supervisory Training Executive Development. Training Evaluations and Validations. The four levels of Training evaluation and the measures.

Suggested Reading

Dynamics of Industrial Relations, MamoriaMamoria, Himalaya Publishing House.

Industrial Relations, Venkatratnam, Oxford Books.

Taxman's Labour Laws, New Delhi, Taxman Services Ltd, 2003

P.R.N.Sinha et al; Industrial Relations, Trade Unions, and Labour Legislation; Pearson Education; Delhi, 2006; chapters 15 to 29.

P.K.Padhi; Labour and Industrial Laws; Prentice Hall of India Ltd, Delhi, 2007.

Blanchard, P. Thacker, J.W. (2007) Effective training Systems, strategies and Practices (3rd Edition) PHI New Delhi.

Goldstein and Ford, (2007) Training in Organization (4th Edition) Cengage Learning, New Delhi.

Lynton, R. Pareekh Udai (2005) Training and development Sage publications, New Delhi. 4

(C) MARKETING & SALES

DEMG0108 Entrepreneurship Credits:3(0+3)

Theory

An Overview of Entrepreneurs and Entrepreneurship, Starting Your Small Business, Forms of Ownership, Becoming an Owner, Planning, Entrepreneurial practice. The importance of small business. Entrepreneurial economy. Entrepreneurship and Economic Development. Type of Entrepreneurship. Entrepreneur and small business. Features and types of businesses and entrepreneurs. Sources of business ideas. The role of entrepreneurship in economic development. Terms of entrepreneurship. Innovation and entrepreneurship. Entrepreneurship and small business. The life cycle of a small company. Small business sector in Croatia. Forms of entrepreneurial organization. Sources of capital. Entrepreneurial process. Entrepreneurial strategies. Starting a new company. Buying an existing business. Franchising. Family business. Entrepreneurial project: an entrepreneurial venture and entrepreneurial development chain. Defining the business concept. Writing a business plan. Basics of Venture Marketing. Fundamentals of entrepreneurial management. Small business enterprises. Business process: product design, operational art, stock management. Technical and technological analysis of entrepreneurial projects. Designing a business investment. Knowledge Economy. Entrepreneur biographies - the actual successes and failures. Business results in SMEs. Organizing, and Managing, Obtaining the Right Financing, Developing Marketing Strategies, Promotion and Distribution, Managing Human Resources, Employee Relationships, Basic Financial Planning.

Suggested Reading

Dynamics of Entrepreneurial Development and Management, Vasanta Desai HPH

Entrepreneurship Development, Colombo Plan Staff College of Technical Education (Adapted By Center for research and Industrial Staff Performance, Bhopal) Tata Mcgraw Hill. New Delhi -1998.

DEMG0109

Branding & Marketing

Credits:3(0+3)

Theory

Course Content: Unit I Basics of Brands and Business Branding and brands. Consumer benefits---Rational vs Sensory vs Emotional. Maslow's hierarchy. Consumer Needs vs Wants and the social and family implications. Emergence of new consumer classes and the potential conflicts between generations. Brand Equity & Brand Ideas & Brand Positioning. Branding beyond commerce— politics & religion & charity. Brand Identity Brand Identity & Logos

&Colors& Images. The brand base line.The role of visual and audio properties.Brand promise & Brand Personality. Brand Image, Differentiation, and Competitive advantage through Branding. Market Opportunities and Brand Positioning How to identify opportunities? What is latent need? How to anticipate emerging and changing needs? The foundations of Brand—Consumer relationship.The evolving shift of power and influence. Brand Positioning Statement. Role of Brands in Global Businesses The power of brands, Emotional leverage of brands, Branding to meet the needs of consumers across borders, No Logo and Pro Logo, Sustainability of brands, Repositioning of Brands, Branding mistakes due to cultural negligence. Trends in Brands and Business Latest Trends in Branding, Consumer Trends that have affected Branding strategies, Application of Technology in Branding, Branding strategies for changing consumer attitudes, Case studies.

Suggested Readings

Jean-Noel Kapferer, the New Strategic Brand Management: Advanced Insights and Strategic Thinking, Kogan Page Publishers, 2012

Kevin Lane Keller, Strategic Brand Management, Pearson Education, 2013

Tilde Hedning, Charlotte F. Knudtzen, MogensBjerre, Brand Management: Research, Theory and Practice, Taylor & Francis Limited, 01-Dec2015

LucieScholz, Brand Management and Marketing of Luxury Goods, Anchor Academic Publishing (aap_verlag), 01-Feb-2014

DEMG0110 Digital Marketing Credits:3(3+0)

Theory

Marketing in digital Era: Scope and Context of digital marketing, emerging trends, Role of digital marketing in B2B, B2C marketing, Digital consumer: Online consumer definition & types, Consumer online usage and behavior, Patterns in digital consumption, The Online Marketing Mix, Customer Relationship Management in a Web world.Business Drivers in the Virtual World: Social Media, Online Branding, advertising, PR, Traffic Building, Web Business Models, E-commerce, Digital Strategy & Planning: Key elements in digital planning, planning process (acquisition, development & retention), Key digital channel selection. Online Tools for Marketing: Engagement Marketing through Content Management, Online Campaign Management, Consumer Segmentation, Targeting, and Positioning using Online Tools, Market Influence Analytics in a Digital Ecosystem. The Contemporary Digital Revolution: Online Communities and Co-creation, The World of Face book, The Future of

Marketing—Gamification and Apps, Mobile Marketing, Email Marketing, Search Engine Optimization, Blogs, forums and discussion boards, Viral Marketing, Affiliate Marketing

Suggested Readings

A Complete Guide To Search Engine Optimization – Deepak Bansal

Grienstein and Feinman- E-commerce –Security, Risk Management and Control (TMH, 2nd Ed.)

Ahuja, Vandana, Digital Marketing, Oxford University Press

DEMG0111 Sales and Distribution Management (SDM) Credits: 3(3+0)

Theory

Introduction: Evolution of Sales and Distribution Management, Emerging Trends in Sales and Distribution Management, Linking sales and distribution management; The Selling Process: Roles and responsibilities of salesman, Steps in personal selling, key success factors and measures, the sales tools, product features and benefits, Driving visibility, Positive sales call; Sales Territories and Quotas: Defining and designing sales territories, assigning sales force to territories, Sales Quota. Managing the sales: Persuasion and objection handling, range selling, understanding trade schemes, retailer billing and trade scheme calculations; Promotion in sales: Selling a promotion, Launching a new product, Covering new outlets, Organizing & staffing the Sales force: Types of Sales force organization structure, deciding the size of the sales force, Specialization within the sale organization, Sales force recruitment and training, Controlling the Sales Force: Reviewing own performance, Monitoring sales force expenses, Sales Audit. The Indian Distribution Environment: FMCG industry in India, The product Overview, The consumer and the Shopper, Overview of FMCD & Service Industry; Understanding Key Channel Institutions: Distribution channels in FMCG, Types of distributor, Distributor's overview, Distributors point processes, wholesaling in India, Retailers and their expectations, Types of retailers and coverage. Developing a Distribution Strategy: Developing channel objectives, designing the distribution channel, Use of alternate channels like internet, Managing the distribution channel: Selecting and appointing the channel members, Conducting appraisal of channel partners, Evaluating channel members, Strategies to maintain and enhance channel commitment, Managing conflict among channel members.

Suggested Readings

Venugopal, P. (2005). Marketing Channel Management: A Customer-Centric Approach. New Delhi: Response Books

Kapoor, R. (2005). Fundamentals of Sales Management. Delhi: Macmillan India

Still, R. R., Cundiff, E. W., & Govoni, N. A. P. (1988). Sales Management: Decisions, Strategies and Cases. (5th edition). New Delhi: Prentice-Hall of India

Panda, T. K. & Sahadev, S. S. (2005). Sales and Distribution Management. New Delhi: Oxford University Press

Havaladar, K. K. & Cavale, V. M. (2007). Sales and Distribution Management: Text and Cases. New Delhi: Tata-McGraw-Hill.

DEMG0112 Product Promotion Credits:3(3+0)

Theory

Product Management; Product concept, Classification of products, Product life cycle (PLC), Product Development and Service Design, New Product design, New Product Development. Brand & brand management, what is brand equity. Pricing; Meaning & objective, steps in setting the price, price responses to competition, pricing policies. Promotion; What is promotion, types of promotion, advertising, sales promotion, integrated marketing communication Place; Marketing channels, Channel conflict management, Distribution system and logistic, management Sales management; Basics of sales management, managing sales force, Principle of personal selling Consumer Behavior; Role of consumers, Consumer decision making process, Post purchase behaviour. Managing the product portfolio. Product strategy: 4A of rural marketing, Rural product categories, New product development, Branding in rural markets, Fake brands, Product warranty & after sales services, Pricing Strategy: Pricing objectives, Factors of pricing, pricing strategies, Market entry strategies. Distribution strategy: Challenges and dilemma, Evolution of rural distribution system, Channels involved, Behavior of the channel, Public distribution system (PDS), Cooperative societies, Prevalent distribution models (corporate). The global marketing mix: Products & brand decision, Pricing, Global marketing channels & Physical distribution, Communication, Advertising, Public relation, special form of marketing communication. Product: Designing the Market Offering; Price: Managing Costs of Behaviour Change; Place: Making Access Convenient; Promotion: Creating Messages and Selecting Media Channels.

Suggested Readings

Marketing Management: A South Asian Perspective- Phillip Kotler, Kevin Lane Keller, Abraham Koshy and Mithileshwar Jha, 13th Edition Pearson, Education Publication 2.
Marketing Management: Fourth edition- Rajan Saxena 3. Positioning: The Battle for Your Mind- Al Ries & Jack Trout, Warner Books USA

DEMG0113 Consumer Research Credits :3(3+0)

Theory

Introduction The basic notion of consumer behavior and its importance in marketing.
Motivation Definition, Dynamic nature of motivation, Types & systems of needs. Personality Understanding Personality, Theories of Personality (Freudian, Jungian, neo-Freudian, Trait), Understanding consumer diversity, Self & Self-image. Perception Concept, Absolute Threshold, Differential Threshold, Subliminal Perception, Dynamics of perception (Selection, organization, interpretation). Learning Consumer Learning, Behavioral learning theories (classical conditioning, Instrumental conditioning), Cognitive Learning Theory (Information Processing), Brand Loyalty. Attitude Consumer Attitude: Formation and Change (Process, sources of influence, Strategies and functions), Tri-component & Multi Attribute attitude models. Reference Group Social & Interpersonal Influence, Reference Groups, Consumer Conformity, the Common Man Appeal. Family Family, Role, Functions, Decision Making, Family Life Cycle. Social Class Social Class, Mobility, Signs of downward mobility. Culture Culture, Basics, Values, Myths, Customs, Rituals, Laws, Acculturation, Subculture. Consumer Purchase Decision Making Consumer Decision Making: Levels (Extensive problem solving, limited problem solving, routinized purchase behavior), Models (Nicosia, Howard-Seth model, Engel-Blackwell-Miniard Model), Problem recognition and decision-making, Information search and decision making. Decision making and Post-purchase behavior Evaluation of alternatives, purchase decision making, and post-purchase behavior, marketing applications: Customer satisfaction and dissatisfaction.

Suggested Readings

Consumer Behavior by Schiffman & Kanuk

Consumer Behavior by Loudon Della Bitta

Consumer Behavior by Mowen & Minor 4. Consumer Behavior by William Wilkie 5.

Consumer Behavior by Peter Olson 6. Consumer Behavior by Wells Prensky

(D) RESEARCH & DEVELOPMENT

DEAY0106 Development of Phytopharmaceuticals Credits: 3(3+0)

Theory

Phytopharmaceuticals- new drug class regulated in India; Definition- Phytopharmaceutical Drug; Difference between tradition medicine (Ayurveda, Siddha, or Unani) and Phytopharmaceutical; Process flow of Phytopharmaceutical Drug, Regulatory requirements for phytopharmaceutical drug, Regulatory authority-Central Drugs Standards Control Organization (CDSCO). Regulatory provisions for phytopharmaceuticals and regulatory submission requirements for scientific data on quality, safety and efficacy; Difference between Chemical markers and Biological markers; Bioassay guided fraction and isolation of chemical constituents from plants.

Reference

E-content: Perspect Clin Res. 2016 Apr-Jun; 7(2): 59–61. N arayana DA, Katiyar C. Draft amendment to drugs and cosmetics rules to license science based botanicals, phytopharmaceuticals as drugs in India. J Ayurveda Integr Med. 2013; 4:245–6.

Gazette Notification, MINISTRY OF HEALTH AND FAMILY WELFARE (Department of Health and Family Welfare) New Delhi, the 24th October, 2013 G.S.R.702 (E).
<http://www.egazette.nic.in/WriteReadData/2013/156781.pdf>

DEAY0107 Basics of Biological Screening Credits:3(3+0)

Theory

Introduction to biological screening of drugs. Methods used in biological screening of drugs. Screening of analgesics and anti-inflammatory drugs, Screening of anticonvulsant and anti-parkinsonian drugs. Screening of antidepressant and antipsychotic drugs, Screening of sympathomimetic and sympatholytic, Screening of parasympathomimetic and parasympatholytic. Screening of local anaesthetic drugs Immunoassays. Screening of cardiac inotropes, Screening of anti-anginal and anti-arrhythmic drugs, Screening of cardioprotective drugs. Screening of autacoids. Screening of anti-diabetic drugs. Screening of anti-hypercholesterolemic drugs.

Suggested Readings

Drug discovery and evaluation pharmacological assay, Hans Gerhard Vogel, Springer.
CPCSEA Guidelines

DEAY0108 Basics of Plant Biotechnology Credits: 3(2+1)

Theory

Cell organization and subcellular structure; structure and properties of nucleic acids; Structure and structural dynamics of Chromosome DNA, RNA and proteins; Meiotic and Mitotic process in plant cell. Mechanisms of DNA replication; mutagenesis and processes of DNA repair; transcription; translation; mechanisms of DNA recombination; regulation of gene expression; marker genes; promoters; Biochemistry of major metabolic pathways and products. Genetic engineering for resistance to insects, pests, virus, pathogens and tolerance to herbicides; gene silencing; molecular markers for plant improvement. Plant growth regulators and elicitors, Plant morphogenesis; cellular totipotency; in vitro culture; protoplast isolation and culture; haploid and triploid production; soma clonal variation; *In vitro* breeding and soma clonal variations for crop improvement. Embryo rescue and synthetic seeds; production of secondary metabolites; Cryopreservation and conservation of germplasm. Cell suspension culture development: methodology, Product formation and biomass production in cell cultures. Determination of oxygen transfer rates, Design and analysis of biological reactors: batch, continuous, fed-batch, shear sensitivity; Developments in aeration & agitation in bioreactors; Principles and applications of DNA fingerprinting; detection of GMO in plants; Hairy root induction and their mass propagation in different bioreactor configurations.. Public acceptance issues for biotechnology Case studies from developing and developed countries. Biotechnology and hunger Challenges for the Indian Biotechnological research and industries. , Plant breeder's rights Legal implications.

Practical

Determination of various stages of Mitosis & Meiosis in plant cell, Estimation of DNA in solution & its evaluation by electrophoresis; Estimation of protein in solution; Vertical Gel electrophoresis of protein; Plant cell culture through embryo, leaves and shoot tip.

Development of callus and suspension cultures of plant cells; shear sensitivity; growth and kinetics in suspension cultures; Detection of GMO in plant system. Identification of plant species through molecular markers.

Suggested Readings

H. S. Chawla, *Laboratory Manual for Plant Biotechnology*, Oxford & IBH Publishing Co., New Delhi, 2003

S. S. Bhojwani and M. K. Razdan, *Plant Tissue Culture: Theory and Practice*, Elsevier, 1996.

Slater, N. Scott and M. Fowler, *Plant Biotechnology: The genetic manipulation of plants*, Oxford University Press, 2003.

J. Hammond, P. McGarvey and V. Yusibov, *Plant Biotechnology: New Products and Applications*, Springer Verlag, 1999.

H. Lodish, A. Berk, S. L. Zipursky, M. P. Scott and J. Darnell, *Molecular Cell Biology*, 4th Ed., W. H. Freeman & Co., 2003.

R. Boyer, *Modern Experimental Biochemistry*, 3rd Ed., Pearson Education (Singapore) Pvt. Ltd., 2001.

K. Lindsey and M.G.K. Jones., "Plant Biotechnology in Agriculture", Prentice Hall, 1990. 3. Singh K, "Intellectual property rights on biotechnology", BCIL, New Delhi.

DEAY0109 Herbal Nanotechnology Credits:3(3+0)

Theory

Importance of Nanotechnology-History of Nanotechnology-Opportunity at the nano scale-length and time scale in structures-energy landscapes-Interdynamic aspects of inter molecular forces - Classification of nanoparticles- One-dimension nanoparticles- Two-dimension nanoparticles- Three- dimension nanoparticles. Preparation methods of nanoparticles: Emulsion-Solvent Evaporation Method-Double Emulsion and Evaporation Method- Salting Out Method-Emulsions- Diffusion Method-Solvent Displacement / Precipitation method-Coacervation or Ionic Gelation Method- Polymerization Method-Preparation of Nanoparticles Using Supercritical Fluid Technology -Characterization of Nanoparticles: Dynamic Light Scattering (DLS)- Scanning Electron Microscopy (SEM)- Transmission Electron Microscopy (TEM)- Atomic Force Microscopy. Nanoparticles and their applications in Life Sciences- Types of Pharmaceutical Nanosystems and their applications- Nanostructures in Drug Delivery-Hazards and Toxicity Profile of Nanoparticles-Ayurvedic Bhasma as nanomedicine- Green syntheses of silver nanoparticles using plant extracts- Nanoformulations with Phytochemicals/Extracts

Suggested Readings

Fundamentals of Nanotechnology-by Gabor L. Hornyak, John J. Moore, H.F. Tibbals, Joydeep Dutta, Publisher: CRC Press

The Handbook of Nanomedicine- by K.K Jain, Publisher: Springer

Pal. S.K. The Ayurvedic Bhasma: The Ancient Science of Nanomedicine, Recent Patents on Nanomedicine, 5: 12-18, 2015.

De Jong, HW, Borm, PJ. Drug delivery and nanoparticles: Applications and Hazards, International Journal of Nanomedicine, 3(2): 133-149, 2008.

DEAY0110 Food Technology Credits :3(3+0)

Theory

Introduction -General aspects of food industry, Composition of foods, quality and nutritive aspects, Characteristic features of processed and natural food, Mass and energy balance in food processing operation. Food Rheology - Characteristics of non-Newtonian fluids, Time-independent and time-dependent non-Newtonian fluids, linear viscoelastic fluids. Thermal Processing -Canning/retort processing – process design and equipment's. Equipment design aspects of pasteurizer, sterilizers, evaporators and concentrators. Dryers and their design parameters – tray dryer, spray dryer, fluidized bed dryer. Food Preservation - Microbial Survivor Curves, thermal death of microorganisms and D, Z and F value calculation, Spoilage probability, Food preservation by dehydration, irradiation, Food preservation by adding preservatives. Food Production, Packaging and Storage - Process design aspects for liquid foods such as milk and juices. Concentration with thermal and membranes processes, Food packaging & product shelf life, Modified atmosphere and controlled atmosphere storage, Aseptic packaging, Freezing and Thawing calculations. Food laws - Legislation, safety and quality control.

Suggested Readings

Potter Norman N., Hotchkiss Joseph, Food science, CBS (2005).

Toledo Romeo, Fundamentals of Food Process Engineering, CBS (2007).

Potty V.H. and Mulky, M.J., Food Processing, Oxford and IBH (1993).

Heldman D.R. and Singh R.P., Food Process Engineering, Chapman and Hall (1984) 3.

Frazier, Food Microbiology, Tata McGraw Hill, (2007).

(E) PROFESSIONAL ELECTIVES

DEMG0114 Negotiation Skills and Conflict Resolution Credits:3(3+0)

Theory

The Political Analysis of Negotiation: How Who Gets What and When, Negotiations: Theory and Reality" , Negotiation as a Joint Decision-Making Process, Negotiating from Asymmetry, Common Elements in the Analysis of the Negotiation Process, Pre-Negotiations: Phases and Functions, Negotiations: The Beginning, The Middle, and The End, The Economic Analysis of Negotiation and Lessons for Theory, Escalation and Ripeness in International Negotiations, Beyond the Hurting Stalemate. Case Studies & mini practice

sessions: Conflict management as a first party and as a third party: third-party skills include helping others deal directly with their conflicts, mediation, investigation, arbitration, and helping the system change as a result of a dispute.

Suggested Readings

Lewicki, Roy J., David M. Saunders, and John W. Minton. *Essentials of Negotiation*. 2nd ed. Irwin, 2000. This is a new paperback – not the same text as last year.

Moore, Christopher W. *The Mediation Process*. 2nd ed. Jossey-Bass, 1996.

Ury, William. *Getting Past No: Negotiating with Difficult People*. Bantam, 1992.

Other readings are on sale in the campus copy center, (15.667 Class Notes).

DEMG0115

Basic Email Etiquette

Credits:3 (3+0)

Email and its History, Basics of Email writing, building relationships with your writing, write as you speak, considering the readers condition, punctuations and vocabulary, utility of verbs, positive writing in Emails, Act on Emails: save, delete and forward.4R's: Reader, Response, Reaction, Results. Plain and simple Language and its effects. Thank you note.

Suggested Readings

E-mail: A Write it Well Guide : how to Write and Manage E-mail in the Workplace, Book by Janis Fisher Chan

Strategic Business Letters and E-mail, Book by Sheryl Lindsell-Roberts

DEAY0112

Interpersonal Skills/Listening and Speaking

Credits:3(3+0)

Theory

Friendly Communication: Doing Things with Words: To ask for information, help, permission; To instruct, command, request, accept, refuse, prohibit, persuade, Practice of Formulaic Expressions: Greetings, farewells, introductions, thanks, apologies, regrets, good wishes, congratulations, condolences, offers. Conversation: Practice in familiar and unfamiliar situations, Grammar and Vocabulary: Elimination of common errors, Editing passages, Word power A-Z: Easy and quick techniques, Vocabulary building exercises. Phonetics And Spoken English: Pronunciation Guidelines: Consonants and Vowels , Pronunciation practice (for accent neutralization), particularly of problem sounds, in isolated words as well as sentences , Speaking Techniques: Using correct stress patterns, developing voice quality, Rhythm and Intonation: Reading aloud of dialogues, speeches etc. for practice in pronunciation. Listening Skills: Listening Process, Hearing and Listening, Types and Barriers, Effective Listening Strategies. Common forms of Oral Communication in the

Business World: Meetings: Organize Meetings, Preparing an Agenda, Chairing a Meeting, Drafting Resolutions, Writing Minutes. Persuasive Speaking: Improving Fluency and Self-Expressions, Articulation, Good Pronunciation, Voice Quality, Making an Oral Presentation: Planning, Preparing and Delivery.

Suggested Readings

Dwyer, J. (2000). The Business Communication Handbook. New Jersey: Prentice Hall.

Brown, G & Yule, G. (1983). Teaching the Spoken Language. Cambridge: Cambridge University Press.

Brown, H. D. (1994). Teaching by Principles: An Interactive Approach to Language Pedagogy. New Jersey: Prentice Hal

DEMG0116 Presentation Skills and Group Discussion Credits:3(3+0)

Theory

Technical Communication Essentials: Planning, Preparing, Organizing and Seminar Presentation. Document Design: Creation and use graphics that complement your business and technical communication. Communicating in the Workplace, Technical Writing Process Today, Readers and Contexts of Use, Ethics in the Technical Workplace. Designing Documents and Interfaces, Creating and Using Graphics. Group Discussions: Debate and GD, Types of GD, GD Etiquette: practicing short dialogues, JAM, group discussions, debates, speeches, listening to news bulletins, viewing and reviewing documentaries and short films etc.

Suggested Readings

An Introduction to Professional English and soft skills by B.K Das et al., Cambridge University Press

DEAY0113 Research report writing Credits:3(3+0)

Theory

Technical Communication Strategies and Researched Report Writing, Defining terms clearly in technical documents. Instructions and processes. Proposals for business and technical situations. Research and manage information. Analytical report writing. Researching and

Managing Information, Organizing and Drafting, Technical Definitions, Technical Descriptions, Instructions and Documentation, Proposals, Analytical Reports.

Suggested Reading

Gerson, Sharon J. and Gerson, Steven M. (2007). Technical Writing Process and Product. Delhi: Pearson Education.

Effective Technical Communication, M. Ashraf Rizvi, TMH Publications.

Business Communication Today, Courtland L Bovee, John V Thill & Mukesh Chaturvedi, Pearson Education.

DEAY0114 Business Communication Credits:3(3+0)

Theory

Understanding Communication In Business: General Communication and Business Communication, Communication in Organizational Settings: Patterns of Communication in the Business World – Upward, Downward, Horizontal Grapevine etc, Channels of Communication- Internal and External, Formal and Informal, Introduction to Cross Cultural Communication, Strategies to Overcome Communication Barriers. Reading and Writing: Competency in reading and writing skills through such tasks/activities as reading books, articles, magazines, novels, developing outlines, key expressions, situations, slogan writing and theme building exercises, dialogue writing, interpreting pictures, technical writing. Sub-Skills of Reading: Predicting Content, Skimming & Scanning, Topic sentence and supporting details, Inferential Reading, Guessing the Meaning of Unfamiliar Words, Note Making. Importance of Writing Skills and Principles of Effective Writing, Writing Process: Pre-writing, Drafting and Re-Writing, Paragraph Writing, Summaries and Abstracts, Business Correspondence: Writing Business Letters, E-mail Messages, Memo, Notice, Circulars, Reports, Proposals, Career Communication: Writing Resume/ CV and Job Application Letter.

Suggested Readings

An Introduction to Professional English and soft skills by B.K Das et al., Cambridge University Press

Effective Technical Communication, M. Ashraf Rizvi, TMH Publications.

Business Communication, Krizan. Merrier. Logan. Williams, Thomson

Business Communication Today, Courtland L Bovee, John V Thill & Mukesh Chaturvedi, Pearson Education.

Business communication by Meenakshi Raman and Prakash Singh (Oxford)

Business Communication, Urmila Rai & S.M Rai, Himalaya Publishing House