SANT GADGE BABA AMRAVATI UNIVERSITY GAZETTE

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PART- TWO

Thursday, the 25th February, 2021

NOTIFICATION

No. 25/2021 Date : 25 /02/2021

Subject :- Implementation of new syllabi of Semester I to IV of the Course M.E. (Environmental Engineering) (F.T.) (Two Year Semester Pattern) (Choice Based Credit System) in the Faculty of Science & Technology from the session 2020-2021 & onwards..

It is notified for general information of all concerned that the authorities of the University have accepted to implement the new syllabi of I to IV of the Course M.E. (Environmental Engineering) (F.T.) (Two Year Semester Pattern) (Choice Based Credit System) from the academic session 2020-2021 and onwards as per **Appendix – A** :

Sd/-
(Dr.T.R.Deshmukh)
Registrar
Sant Gadge Baba Amravati University

Appendix – A

SYLLABUS OF M.E. (ENVIRONMENTAL ENGINEERING) (F.T.) (TWO YEAR SEMESTER PATTERN) (C.B.C.S.)

SEMESTER: FIRST

CORE I (1SFEE1) : ENVIRONMENTAL MICROBIOLOGY

Course Objectives:

1. The main objective is to know and understand the role of microbes in biogeochemical processes in different ecosystems.
2. The students will learn the basic microbiological principles, the methods in microbial ecology and theoretical and practical use.
3. To create base for understanding processes and changes in environment.

Course Outcomes:

At the end of the course the student will be able to:

1. Acquire basic knowledge regarding preparation and perform sampling and microbial analysis to determine the growth rate, micro community composition with the basic environmental parameters.
2. Use the knowledge to prevent infections to human and environmental health.
3. Acquire basic knowledge to determine the role of microbes in different habitat, in nutrient recycling, water quality determination and in degradation of natural organic compounds and pollutants in the environment.

SECTION –A

Unit I : Introduction to microbiology : Classification of microorganisms,prokaryotic cells, eukaryotic cells. Characterization of microorganism,microorganism of importance. Distribution of biological forms,interrelationship application in the field of Environmental Engineering.

Unit II : Bacteria : Distribution, cytology, forms size, morphology and filestructure of bacteria, nutritional requirements, metabolism, growthof bacteria, growth patterns, food microorganism relationship,Aerobic, Anaerobic growth. Factor affecting growth, generation time.

Bacteriology of water : Pathogens and indicator of pollution, methodof isolation, enumeration and differentiation. Presumptive,confirmative and completed test for E-coli, most probable number,Membrane filter technique, indicators of pollution, sampling method,frequency, precautions.

Microbiology of food : Microorganisms associated with milk andfood, diseases transmitted, food poisoning.

Unit III : Enzymes : Nature of enzymes, mode of actions, effect of temperature,pH, salts and heavy metal, extra cellular and intracellular enzymesclassification, source of enzymes, enzymes formation.
Fresh water biology : Flora and fauna in rivers, distribution, limnology,biological cycles, oxygen concentration, nutrient concentration,oxygen depletion, oxygen sag reaeration, Lake eutrophication andits prevention.

SECTION - B

Unit IV: Algae, Fungi Protozoa and viruses: General, introduction to thesegroups, their role in environmental Engineering and theirclassification, identification, observation nutrition, reproductions,their control.
Viruses: Occurrence, special features, diseases caused by them,culturing, control of viruses.

Unit V: Bacterial culture: Isolation of microorganisms, staining procedures,pure and mix cultures, culture characteristics, different medias,selective methods, interference, gram positive and negative bacterialaboratory culturing techniques, equipments used, microscope,autoclave, incubator, test chamber. Microbiology of waste water treatment: Microorganisms, fundamentaltheory, theory of operations, oxygen requirements and environmentalfactors associated with following waste treatment methods.
· Activated sludge process
· Trickling filter
· Oxidation pond
· Sludge digestion
· Cesspools, septic tank and Imhoff tank.

Unit VI: Air microbiology: Types of microorganisms, Air borne diseases,sampling of air, microbial content of air, control of airborne diseases.
Control of microorganisms: Death of bacteria, Pattern of death,effect of temp pH, toxic substances on growth of bacteria, Antagonismand synergism. Control of microorganisms by physical ageControl of microorganisms by chemical agents.

Recommended Books:
1. Microbiology for Environmental Scientist and Engineers, Anthony Gaudy, Elizabeth Gaudy, McGraw Hill Int. Book Co., 1980.
2. Microbiology for Sanitary Engineers, R. E. Mckinney, McGraw Hill Int. Book Co., 1967
3. Microbiology of Water and Sewage, P. L. Gainey., Prentice Hall Inc., 1952
4. Microbiology, M. J Pelczar., E. C. S. Chan, Tata McGraw Hill, 1986
5. Environmental Biology, Mukherjee, Tata McGraw Hill Publishing. Co. Ltd,1996.

CORE II (1SFEE2) : ENVIRONMENTAL SCIENCES AND CHEMISTRY

Course Objectives:
1. Understanding the concept and importance Environmental problems, Climatology&meteorology,Ecology and global atmospheric change.
2. To provides an in depth knowledge of basics of chemistry, variety of reactions and introduces equilibrium chemistry.
3. To lays foundation of electrochemistry, colloidal and surface chemistryto know instrumental methods of analysis.

Course Outcomes :
At the end of the course the student will be able to:
1. Explain the environmental problems and climates
2. Explain ecology & global atmospheric change
3. Explain chemical reactions and their importance. Physical chemistry. potential.
4.Classify organic and biochemistry. Formulate enzymatic relationships using kinetics
5. Perform different techniques for measuring waste water quality parameters. colloids, discuss their properties and their environmental significance.
6. Apply the knowledge of chemistry for water treatment process like coagulation,softening etc.

SECTION – A

Unit I : The Nature and scope of Environmental Problems :- Interaction of systems,Environmental disturbances, public awareness and action, Quantificationof Environmental problems.
Climatology and Meteorology: - Introduction, Basic atmospheric properties,Energy outputs and inputs, wind stability and turbulence, water in theatmosphere, climate.

Unit II : Ecology :- Introduction, Energy flow in Ecosystems, food chain and trophiclevel, elements of limnology, Eutrophication.
Global Atmospheric change :- The greenhouse effect and stratosphereozone depletion, Global temperature, the greenhouse effect, carbon dioxide,chlorofluorocarbons, the greenhouse gases, changes in stratospheric ozone.

Unit III : General Chemistry: - Law of mass action, Stoichiometry, Gas Laws.
Physical Chemistry: - Types of solution, electrical conductivity and aqueoussolution, ionic theory, electrical dissociation, Buffer solutions, Indicators,Solubility products, Common ion effect, Amphoteric hydroxides, chemicalequilibrium and ways of shifting it.

SECTION- B

Unit IV : Organic Chemistry and Biochemistry : Organic compounds of interest toenvironmental engineers (Details of preparation and chemical reactionsinvolved are not required)General preparation of the functional groups of organic compounds.Enzymes, classification, Enzyme carbolized reactions.

Unit V : Break down and synthesis of carbohydrates, fats, protein under aerobicand anaerobic reactions.CNP cycle under aerobic and anaerobic reactions.Concept of B.O.D., C.O.D., T.O.C.Colloids, Dispersion of Colloids, General and electro kinetic properties ofcolloids, colloidal solutions and mixtures.

Unit VI : Environmental Chemistry :- Water structure and anomalous behavior ofwater, Chemistry involved in water treatment processes like coagulation,disinfection, softening, fluoridation, defluorination, Iron and its control.
Composition and characterization of sewage, sewage sludge and gasanalysis.
Chromatography: - Principles and uses in Environmental Engg.

Recommended Books:
1) Introduction to Environmental Engg. and Science By Gilbert MMasters.
2) Environmental Science ByAlam Singh, Vol-I, II, III.
3) Environmental Science & Engg. By Henry.
4) Fair G M, Geyr J C, Okun D A, Water and Wastewater Engineering,Vol, I &II, John Wiley & Sons, New York.
5) Chemistry for Environmental Engg. By Sawyer & McCarty.

PROGRAM ELECTIVE – I (1SFEE3) : (1) WATERSHED MANAGEMENT

Course Objectives:
1. To understand the concept of hydrology and hydrological cycle.
2. To study the hydrology of groundwater.
3. To provide knowledge regarding watershed development and management.

Course Outcomes:
At the end of the course the student will be able to:
1. Explain the concept of hydrological cycle in detail.
2. Understand the hydrology of ground water.
3. To apply knowledge of watershed development and management.

SECTION – A

Unit I: Introduction : The hydrological cycle, storage, concept of storage, the watershed.
Water and Energy: Energy movement, quality of energy, the geometry of energy, the energy budget, Instruments and limitations,the role of water in energy sphere.

Unit II: Water in Vegetation: Processes, interception, Transpiration,Evapotranspiration, calculations by using water budget,Evapotranspiration, models, storage.

Unit III: Hydrology in water resources development, statistical analysis ofrainfall and runoff, different distributions methods, Estimation of UnitHydrograph-flood flow formulae, Storm hydrograph, Storage andregulation of runoff-safe yield of streams, Estimate of storage requirements.

SECTION– B

Unit IV : Hydrology of Ground Water : Common aquifers-Exploration for ground water, hydraulics of ground water flow- Measurement of permeability of formations, flow nets and their constructions.
Boundary conditions – Unconfined and Confined, steady and unsteady flow into wells and infiltration galleries – Evaluation of formulation constant interference, Method of images – Types, design, construction and maintenance of wells and infiltration galleries, Development of wells – well strainer – functions and selections, field tests – Hydraulics of salt water intrusions and their prevention,Ground water recharge.

Unit V : Watershed Development and Management : Definition,Need and scope, characterization of watershed criteria survey, Basic data collection and interpretation, Establishment of watershed research stations. Watershed resource evaluation and management.Irrigation technology. Integrated farming system. Project formulation and economic analysis.
Perspective of Watershed Management: Methodologiesfor modifying the water resource environment, watershedmanagement and large-scale changes.

Unit VI : Practice of Watershed Management: Rehabilitation,Protection and Enhancement.
Non-Point Sources of Pollution: The legal basis, the process of non-point source pollution control, Best management practicesprinciples, Best management practices on wet lands.
Rain Water Harvesting: Necessity, Methods of rain waterharvesting, Requirements for design of project, communityparticipation, Role of NGO's, Government and Municipal Corporation,Limitations, quality assurance of stored water.

Recommended Books:
1. Watershed Hydrology by Peter E. Black.
2. Water Resources Systems, Planning and Management by R. N.Chaturvedi.

PROGRAM ELECTIVE – I(1SFEE3) : (2) ENVIRONMENTAL GEOTECHNOLOGY

Course Objectives:
1. To study the concept of contamination and contamination of solid waste in landfills.
2. To study the different containment systems using Geo-membrane.
3. To provide the knowledge regarding contaminants of slurry wastes.

Course Outcomes:
At the end of the course the student will be able to:
1. Understand the concept of contamination in detail.
2. Apply knowledge regarding different containment systems.
3. Make geotechnical reuse of Waste material.

SECTION A

Unit I : Contamination: Surface & subsurface contamination, Sources and effects of subsurface contamination, Physical, Chemical and biological characteristics of solid waste, Identification, Characterization and regulatory requirements for disposal of hazardous, non-hazardous and domestic waste Soil-waste interaction, Effect of pollutants on soil properties

Unit II : Contaminants of solid waste in landfills: Characteristics of solid wastes, Disposal of solid waste, Stabilization and solidification of solid waste, Waste containment, Solid waste Landfills and its components, Shape and size of landfills, Types of landfills, Site selection Impervious barriers for liners and Covers, Liner systems and cover systems, , Landfill construction and operation, Leachate generation, Leachate collection and detection system , Closure and post-closure care, Sustainable waste management, Ground water contamination associated with leachate transfer

Unit III : Containment systems using Geo-membrane: Advantages of using composite barrier for Liners and Covers, Single composite liner system for MSW landfill, Double composite liner system for HW landfill, Stability of landfills.

SECTION - B

Unit IV : Contaminants of slurry wastes: Slurry transported waste, Slurry Ponds and their operation, Embankment construction methods for ponds, Design aspects, Environmental impact and control,

Unit V : Vertical barriers for containment: Contaminated sites, Types of vertical barriers, - Soil-bentonite slurry trench walls, and Cement-Bentonite slurry trench walls -construction and design aspects.

Unit VI : Geotechnical reuse of Waste material: Waste reduction, Use of waste in Geotechnical construction, Waste characteristics for soil replacement, Transportation consideration, Engineering properties of waste, Waste material in embankment and fills.
Reclamation of contaminated site, various methods.

Recommended Books:

1. Mitchell, J.K and Soga, K., Fundamentals of Soil Behaviour, John Wiley and Sons Inc., 2005.
2. Fang, H-Y., Introduction to Environmental Geotechnology, CRC Press,1997.
3. Daniel, D.E, Geotechnical Practice for Waste Disposal, Chapman and Hall, 1993.
4. Rowe, R.K., Quigley, R.M. and Booker, J.R., Clay Barrier Systems for Waste Disposal Facilities, E & FN Spon, 1995.
5. Rowe, R.K, Geotechnical & Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001.
6. Reddi, L.N. and Inyang, H.F, Geoenvironmental Engineering - Principles and Applications, Marcel Dekker Inc, 2000.
7. Sharma, H.D. and Lewis, S.P, Waste Containment Systems, Waste Stabilization and
8. Landfills: Design and Evaluation, John Wiley & Sons Inc., 1994.

PROGRAM ELECTIVE – I (1SFEE3) : (3) HAZARDOUS WASTE MANAGEMENT

Course Objectives:
1. To provide knowledge regarding hazardous wastes.
2. To characterize Hazardous Wastes and be able apply different site treatments.
3. To provide information regarding Basic Disaster Management Aspects and long term measures.

Course Outcomes:
At the end of the course the student will be able to:
1. Understand the concept of hazardous wastes.
2. Do the assessment of hazardous sites for waste minimization and resource recovery.
3. Implement long-term measures for prevention of hazardous wastes.

SECTION – A

Unit I : Introduction to Hazardous Waste: Definition, Problems, general awareness, Industry and Government's perspective. Risk Assessments, Environmental legislation.

Unit II : Hazardous Waste Characterization and site Treatment. Introduction, study of characterization, Assessment of Hazardous sites, waste minimization and Resource Recovery, chemical, physical and biological treatment to Hazardous waste. Thermal process.

Unit III : Transportation of Hazardous wastes, container for Hazardous waste, bulk transport, Non bulk transport.Hazardous Wastes (Handling, Storage &Management) Rules, 1989 of MoEF. Introduction.

SECTION - B

Unit IV : Groundwater Contamination: Effect on human health, Historical uses and abuses, hydrology, Detection, Control and Mitigation of groundwater contamination.
Process Techniques and Disposal: Selecting the process, siting the facility, integrated landfill system as Disposal sites, developing a new facility, and operating a landfill.

Unit V : Basic Disaster Management Aspects: The significance of Disaster, the Disaster threat, National Disaster Management policy, major Requirement for coping with Disaster Management cycle, Disaster and National Development, Disaster legislation, counter disaster resources. International Disaster Organisation, utilisation of Resources.

Unit VI : Long-Term Measures: Prevention, Mitigation. Major factors for occurrence of Disaster impact: - Response to Disaster impact: - Major post impact factors, Disaster management support requirements.

Recommended Books:

1. Hazardous Waste Management: Charles A. Wentz., McGraw-Hill, New York,1989.
2. Hazardous Waste Minimization, Harry M. Preeman, McGraw-Hill, 1989
3. Hazardous Waste Chemistry, Toxicology and Treatment, Stanly E.Manahan, 1st edition,CRC-Press, 1990.
4. Disaster Management: A Disaster Manager's Hand Book, W. Nick Carter, ADB Publ., Manila,1991
5. Hazardous Waste Management, Wentz, Charles A., McGraw-Hill, 1989
6. Hazardous Waste Management, LaGrega, Michael D. Buckingham, Philip L. Evans and Jeffrey C., McGraw-Hill, 1989

PROGRAM ELECTIVE – II (1SFEE4) : (1) AIR POLLUTION

Course Objectives:

1. Understanding of basic concepts of air pollution.
2. Study of air pollution episodes.
3. Study of sampling types and methods for ambient air and stack.
4. Study of macro and micro meteorology for understanding the dispersion of pollutants.
5. Simple and complex modeling for point source, line source and area source.
6. Study of pollution control methods, mechanism and devices.

Course Outcomes:

At the end of the subject the students will be able to:

1. Identify air pollution problems and interpret criteria air quality data.
2. Recognize various environmental transformation processes of pollutants under extreme weather condition.
3. Interpret meteorological data and develop capability to assessment of project proposal, air quality pollution index for any region.
4. Justify the use of pollution control equipment and their design.

SECTION - A

Unit I : Elements of air pollution: Definition and classification, History of air pollution, Natural versus polluted atmosphere, Air quality, Sources of air pollution.Air pollution episodes.

Unit II : Effects of air pollution: Effect on human health, on vegetation and animals, on material.

Unit III : Measurement and monitoring of air pollution: Atmospheric Chemistry, Ambient air sampling, Ambient air pollutants, air pollution-monitoring & surveillance.

SECTION - B

Unit IV : Meteorology of Pollution : Physics of atmosphere,Meteorological bases of Atmospheric pollution, Transport & dispersion of air pollutants, air pollution modelling& prediction, Wind rose.

Unit V : Regulatory Control of air pollution: Air quality criteria & standards Elements of Regulatory Control.

Unit VI : Engg. Control of air pollution: Engg. Control concept, control device &systems, Control of stationery sources, Control of mobile sources, source sampling & monitoring.

Recommended Books:

1) Air Pollution, Vol. I To IV – A. C. Stern.
2) Fundamentals Of Air Pollution – Stern, Wohlers, Bouble, Lower.
3) Air Pollution & Control – P. P. Mowli& N. Venkata Subbayya.
4) Air Pollution – Rao & Rao.
5) Air Pollution Sienfeld J. H.
6) Air Pollution – Perkins.
7) Air Quality Monitoring – A Course Manual By NEERI, 19981.
8) Mechanical handbook
9) Mechanical Handling - Jolley, F. Raby, & H. Walder.
10) Fundamentals of Air pollution – R. W. Boubel, D. L. Fox, A. C. Stern

PROGRAM ELECTIVE – II (1SFEE4) : (2) RURAL WATER SUPPLY AND SANITATION

Course Objectives:

1. To provide knowledge regarding rural water supply.
2. To understand the concept of rural sanitation.
3. To provide knowledge of solid waste management.

Course Outcomes:
At the end of the course the student will be able to:
1. Recognize different issues of rural water supply.
2. Explain compact and simple wastewater treatment units and systems in rural areas.
3. Determine non-conventional energy resources.

SECTION A

Unit I : Rural Water Supply: Issues of rural water supply, various techniques for rural water supply- merits, National rural drinking water program- rural water quality monitoring and surveillance, operation and maintenance of rural water supplies.

Unit II : Low Cost Water Treatment: Introduction – Epidemiological aspects of water quality methods for low cost water treatment, Specific contaminant removal systems.

Unit III : Rural Sanitation: Introduction to rural sanitation, Community and sanitary latrines, Planning of wastewater collection system in rural areas, Treatment and Disposal of wastewater, Compact and simple wastewater treatment units and systems in rural areas, stabilization ponds - septic tanks - Imhoff tank- soak pits- low cost excreta disposal systems- Effluent disposal.

SECTION B

Unit IV : Industrial Hygiene And Sanitation: Occupational Hazards- Schools- Public Buildings Hospitals- Eating establishments- Swimming pools, Cleanliness and maintenance and comfort- Industrial plant sanitation.

Unit V : Solid Waste Management: Disposal of Solid Wastes- Composting- land filling incineration- Biogas plants, Rural health - Other specific issues and problems encountered in rural sanitation.

Unit VI : Non-conventional energy sources.
Anaerobic digester: terms, principle and theory associated with Anaerobic digestion, Design of Gobar gas plant, construction aspect associated with gobar gas plant, operation and maintenance of gobar gas plant.
Solar power plant: terms, principle and theory associated with solar power generation, suitability and adaptability of solar power plant for rural area, Design of solar power plant for given capacity, construction aspect associated with solar power plant, operation and maintenance of solar power plant.

Recommended Books:
1. Eulers, V.M., and Steel, E.W., Municipal and Rural Sanitation, 6th Ed., McGraw Hill Book Company, 1965
2. Park, J.E., and Park, K., Text Book of Preventive and Social Medicine, BanarsidasBhanot, 1972
3. Wright, F.B., Rural Water Supply and Sanitation, E. Robert Krieger Publishing Company, Huntington, New York, 1977
4. Juuti, P., Tapio S. K., and Vuorinen H., Environmental History of Water: Global Views on Community Water Supply and Sanitation, IWA Publishing (Intl Water Assoc), 2007

PROGRAM ELECTIVE – II (1SFEE4) : (3) ENVIRONMENTAL STATISTICS AND OPTIMIZATION TECHNIQUES

Course Objectives:
1. To study the sampling and estimation theory.
2. To provide knowledge of various tests of hypothesis and significance.
3. Differentiate different O.R. techniques.

Course Outcomes:
At the end of the course the student will be able to:
1. Explain the sampling theory and estimation theory.
2. Carry out various tests of hypothesis and significance.
3. Evaluate linear programming, transportation and non-linear programming problems.

SECTION A

Unit I : Sampling Theory: Population Parameter, Sample Statistics, Sampling distributions, Sample mean, Sampling distribution of means, the sample variance, the sampling distribution of variance.

Unit II : Estimation Theory: Point estimate and interval estimates reliability, confidence interval estimates of population parameters, confidence intervals for means, proportions and variance.

Unit III : Tests of Hypothesis and Significance: Statistical decisions, tests of hypotheses and significance, Type I and Type II errors, level of significance, one tailed and two tailed tests. Tests involving small samples and large samples, fitting theoretical distributions to sample frequency distribution, The chi-square test for goodness of fit.

SECTION B

Unit IV : Linear Programming: Formulation of linear programming problem, Graphical solution- simplex method (including Big M method and two phase method), dual problem- duality theory, dual simplex method, revised simplex method.

Unit V : Transportation problem: existence of solution-degeneracy- MODI method; Assignment problem-traveling salesman problem

Unit VI : Nonlinear programming problem (NLPP): Constrained NLPP, Lagrange's multipliers method – convex NLPP, Kuhn-Tucker conditions

Recommended Books:

1. Environmental Statistics and Data Analysis, Wayne R. Ott, CRC Press, 1994
2. Environmental statistics: Methods and Applications, V Barnett, John Wiley & Sons Ltd, 2004
3. Environmental Statistics with S-Plus, Steven P. Millard, Nagaraj K. and Neerchal,CRC Press 2001
4. Probability and Statistics, M.R. Speigel, McGraw Hill,
5. Operation Research, H.A. Taha, Prentice Hall of India Pvt. Ltd.
6. Introduction to Optimisation: Operations Research, J.C. Pant,Jain Brothers, New Delhi. Probability and Statistics for Engineers. Miller and Freund.

MLC (1SFEE5): RESEARCH METHODOLOGY AND IPR

Course Objectives:

1. To study the meaning, sources of, criteria and characteristics of a good research problem.
2. To provide knowledge regarding effective literature studies, approaches, analysis, Plagiarism and Research ethics.
3. To provide information regarding Patent Rights and new development in IPR.

Course Outcomes:

At the end of the course the student will be able to:

1. Evaluate the problems related to research work.
2. Apply effective technical writing skills for research work.
3. Gain knowledge regarding patient rights.

SYLLABUS

1. Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, Research problem, data collection.

2. Effective literature studies approaches, analysis,Plagiarism, Research ethics,

3. Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

4. Nature of Intellectual Property: Patents, Designs, Trade and Copyright, Process of Patenting and Development: technological research, innovation, patenting, development. Procedure for grants of patents

5. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

6. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Recommended Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

AUDIT COURSE – I (1SFEE6) :

(1) ENGLISH FOR RESEARCH PAPER WRITING

Course Objectives:

1. To provide knowledge to improve the writing skills and level of readability.
2. To make one understand what to write in each section.
3. To be able to work on the skills needed while writing a Title.

Course Outcomes:

At the end of the course the student will be to:

1. Improve their writing skills and level of readability.
2. Improve key skills while writing a Title.
3. Ensure the good quality of paper at very first-time submission.

SYLLABUS

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Key skills key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions, useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Recommended Books:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM.
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

AUDIT COURSE – I (1SFEE6) : (2) VALUE EDUCATION

Course Objectives:

1. Inculcate the value of education and self- development.
2. To imbibe good values in students.
3. Let the student know about the importance of character.

Course Outcomes:

At the end of the course the student will be to:

1. Gain knowledge regarding social values and individual attitude.
2. Have the attitude of Sense of duty, devotion, self reliance, etc.
3. Improve their personality and behaviour towards others.

SYLLABUS

Recommended Book:

Chakroborty, S.K."Values and Ethics for organizations Theory & practice", Oxford University Press, New Delhi.

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements
- Importance of cultivation of values.
- Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity. Power of faith, National Unity.
- Patriotism. Love for nature,Discipline
- Personality and Behavior Development - Soul and Scientific attitude.
  Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature
- Character and Competence –Holy books vs. Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively.

AUDIT COURSE – I (1SFEE6) : (3) PEDAGOGY STUDIES

Course Objectives:

1. To Understand the Theories of learning, Curriculum and Teacher education.
2. To Understand the Conceptual framework and Research questions.
3. To provide Overview of methodology and Searching.

Course Outcomes:

At the end of the course the student will be able to:

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

SYLLABUS

- Introduction and Methodology:
- Aims and rationale, Policy background, Conceptual framework andterminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions.
- Overview of methodology and Searching.
- Thematic overview: Pedagogical practices are being used by teachers informal and informal classrooms in developing countries.
- Curriculum, Teacher education.
- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school?
- curriculum and guidance materials best support effective pedagogy
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

- Professional development: alignment with classroom practices and follow-up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes
- Research gaps and future directions
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Recommended Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of
3. Curriculum Studies, 36 (3): 361-379.
4. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education
5. Research project (MUSTER) country report 1. London: DFID.
6. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of
7. Basic maths and reading in Africa: Does teacher preparation count? International Journal
8. Educational Development, 33 (3): 272–282. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education.
9. Oxford and Boston: Blackwell.
10. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

CORE LAB I (1SFEE7) : ENVIRONMENTAL ENGINEERING LAB - 1

Determination of :-
1) Conductivity
2) pH (indicators and pH meter)
3) Turbidity
4) Hardness (Calcium and total by EDTA method)
5) Sulphate
6) Chlorides
7) Chlorine demand and Chlorine residual (Available, Break point dose)
8) Nitrogen all types
9) DO, BOD
10) COD, TOC
11) Iron and Manganese
12) Acidity and Alkalinity
13) Fluorides
14) Solids (Fixed, suspended and Volatile)

CORE LAB – II (1SFEE8) : ENVIRONMENTAL ENGINEERING LAB - 2

1) Study of instruments.
2) Heterotrophic plate count.
3) Preparation of differential media
4) Isolation of bacteria by various methods,
5) Staining of bacteria,
6) Enumeration of bacteria by various methods,
7) M.F. technique, Control of microorganisms.

SEMESTER: SECOND

CORE III (2SFEE1) : ADVANCED WATER TREATMENT TECHNOLOGY

Course Objectives:

1. To provide an overview of both the theoretical and practical aspects of conventional and advanced water technology for surface water treatment.
2. Select an appropriate treatment process for a specific application, and be able to identify appropriate pre-treatment and post treatment schemes, and cleaning protocols for these processes.

Course Outcomes:

At the end of the course the student will be able to:

1. Explain the water quality parameters, layout of treatment plant.Able to design intake structures.
2. Learn sedimentation and floatation. Able to explain settling equations. mathematical model of unit processes.
3. learn coagulation and flocculation processes
4. Design filter units alongwith filter backwash system.
5. Analyze chemistry of disinfection and to know the kinetics of disinfection. Learn aeration.Understand adsorption process and apply the knowledge of isotherms.Learn and design various miscellaneous treatment processes such as fluoridation/defluoridation,Colour.
6. Explain need for industrial water quality requirements. Learn and design various miscellaneous treatment processes such as softening,Iron & manganese. Able to know the importance of corrosion control.

SECTION A

Unit I : Standards for treated waters. Surface waters. Effects of storage on water quality. Limnology. Water ecology, Thermal stratification. Seasonal Change, lake overturns. Algae, Control measures, quality of underground Waters.Nature and source of impurities. Examination of waters.
Requirements of water treatment facilities. Unit operations, Gravity systems, pumping systems. Period of design, Fluctuations in demand.Intake structures.

Unit II : Principles of sedimentation and floatation. General equations for settling or discrete particulates. Hindred settling, efficiency of an ideal basin, short-circuiting. Sludge moisture content – specific gravity relationship.Up flow and sludge blanket tanks – mathematical model of the unit processes.

Unit III : Theories of chemical coagulation. Nature of colloids. Zeta potential.Coagulant and their specificity. Design of mechanical flocculators. Mean velocity gradient “G”, “Gt” effect of temperature and other variables. Power consumption. Mathematical Modeling.

SECTION B

Unit IV : Theory of filtration. System Parameter and mathematical modeling, size and shape characteristics of granular filtering materials. Preparations of filter sand, Hydraulics of filtration through homogeneous and stratified beds. Performance of slow, rapid, high-rate multiplayer and composite filters. Up flow, two way filter, dual media filter.
Pressure filters. Diatomaceous earth filters. Mico-strainers. Filterability Index.

Unit V : Principles of disinfection. Factors affecting disinfection. Halogens: Chlorine, Iodine and Bromine.
Principles of aeration, System parameters and mathematical model.Methods of aeration. Theories of adsorption. Freudlich equation. Removalof taste and odour by adsorption. Removal of colour. Effects of fluorides. Fluoridation. Removal of fluorides.

Unit VI : Industrial water treatment: Boiler feed water. Softening of water. Reuse of water and conservation of water in industry.
Methods of Iron and Manganese removal. Use of aeration, oxidation, ion exchange and other methods and their control. Theory of corrosion, and corrosion control.

Recommended Books:

1. Water and Waste water Engineering by Fair Geyer and Okun, JohnWilly and Sons
2. Water and Waste water Technology by Mark J. Hammer, John Willyand Sons
3. Water Supply and Sewerage by E. W. Steel and McGhee, McGraw Hill Company.
4. Manual on Water Supply & Treatment, CPHEEO, New Delhi.
5. Physico-Chemical Processes for Water Quality Control by Weber, John Wiley & Sons, 1972.

CORE IV (2SFEE2) : ADVANCED WASTE WATER TREATMENT TECHNOLOGY

Course Objectives:
1. Students should learn the principles of waste water treatment and management.
2. Students should learn the fundamental concepts in waste water treatment technologies, hazardous waste disposal and management issues related to sludge treatment and disposal.
3. Students should acquire process design skills related to waste water treatment.

Course Outcomes:
At the end of the course the student will be able to:
1. Students should be able to describe the unit processes associated with the the waste water treatment systems.
2. Explain the principles of waste water treatment and apply the knowledge in process design.
3. Carry out innovative and creative laboratory exercise related to waste water treatment.
4. Identify the specific pollution problems.

SECTION - A

Unit I : Introduction : Objectives of waste water treatment, Purpose of advanced wastewater treatment, Wastewater quantity and transport and waste water characteristics. Alternative flowcharts, function and basic principles involved in different units of conventional wastewater treatment plant.

Unit II : Process Analysis : Reaction and reaction kinetics, Mass balance, Reactors and their hydraulic characteristics, Practical aspects of reactor design.

Unit III : Physical and Chemical Treatment: Screening, Grit removal, flow equalizations and mixing. Flocculation, sedimentation, flotation. Detailed principles and design aspects of Screening, Grit chamber and Sedimentation tank.

SECTION - B

Unit IV : Principles of Biological Treatment : Kinetics of biological growth, introduction to suspended and fixed film reactors. Concepts of gas transfer and solids separation, Nitrogen and Phosphorus removal from waste water. Concepts of aerobic and anaerobic treatment of waste water. Design of Activated Sludge system using biological process dynamics. Complete design details of Activated Sludge Process. Modifications of ASP. Process concepts and design aspects of Trickling Filters, Rotating Biological Contactors (RBC), Fluidized bed reactor/treatment.

Unit V : Sludge Treatment and Disposal : Aerobic and Anaerobic digestion of sludge, sludge stabilization, dewatering, conditioning and disposal.
Unit VI : Tertiary Treatment : Principles of tertiary treatment, theory of adsorption and factors affecting adsorption. Concepts and different methods of dissolved solids removal. Basic principles of Reverse Osmosis, Ultra-filtration, Electro dialysis, Desalination.

Recommended Books:
1. Wastewater Engineering: Treatment, Disposal & Reuse, By Metcalf & Eddy Inc. Sixth Ed. 2002, McGraw Hill.
2. Introduction to Environmental Engg., By. P.A. Veslind, PWS, Publishing Company, Boston, 1997.
3. Wastewater Treatment and disposal, By S.J. Arceivalla, Marcel Dekker,1981.
4. Wastewater Treatment Plant Planning, Design and Operation, By S.R. Quasim, Holt, Rinehart & Winston N.Y.
5. Activated Sludge Process: Theory and Practices, By N.F Grey, Oxford University Press, 1990.

PROGRAM ELECTIVE – III (2SFEE3) : (1) SOLID AND BIOMEDICAL WASTE MANAGEMENT

Course Objectives:
1. To provide an overview of waste generation, waste characterization and waste management processes.
2. To impart knowledge on solid waste management with emphasis on municipal solid waste management which includes different waste processing options such as pyrolysis, composting, and incineration; designing and operating sanitary landfill.
3. To enrich knowledge about characteristics of hazardous wastes and their management.
4. To make learners focus on energy recovery from biomass, agricultural and industrial wastes for production of biogas, ethanol, methanol and hydrogen.
5. To impart knowledge on industry specific solid waste management practices.
6. To enrich knowledge about characteristics of biomedical wastes and their management.

Course Outcomes:

At the end of the subject the students will be able to:

1. Identify and interpret the criteria for the classification of a substance as a solid waste.
2. Recognize waste minimization and source reduction, assess and describe the procedure for solid and hazardous waste identification and characterization and various waste processing options.
3. Define and elucidate the management, treatment and disposal of hazardous wastes.
4. To assess and develop physical/chemical/biological treatment techniques for the control of hazardous wastes.
5. To address and describe solid waste management including landfill operation.
6. To manage industry specific solid waste issues.
7. To design and execute land reclamation projects.
8. To explain and interpret the regulations concerning the handling, transportation and disposal of municipal, hazardous, radioactive and biomedical wastes.

SECTION A

Unit I : Problems and impactsof solid waste in developing countries; Sources, types and composition of Municipal solid waste, quantity estimation and forecast, Management systems and planning.

Unit II : Characteristics of solid waste: Sampling – physical, chemical and biological analysis, Sources, types and composition of industrial hazardous and toxic wastes, Treatment and disposal methods

Unit III : Collection of solid waste: On site handling and processing; Collection systems and service; Analysis of collection systems, collection routes; Management issues and concerns. Transfer and transport, design requirements.

SECTION B

Unit IV : Composting: Process microbiology, Aerobic and anaerobic composting, parameters affecting, Design considerations, compost control, engineering design and operations

Sanitary Landfill: Process mechanism, Classification, types, siting considerations, engineering design and operations.

Unit V : Incineration: Process details, classification, types, siting considerations, Energy recovery, Pyrolysis, engineering design and operations.

Unit VI : Biogas from solid wastes: Conversion of solid wastes to protein, Legislation and byelaws in solid waste management, Solid Waste (Management & Handling) Rules, 2001.

Biomedical waste Treatment and Disposal: Generation, collection, transport, treatment and disposal.

Recommended Books:

1. Municipal and Rural Sanitation, Ehlens and Steel; Tata McGraw-Hill, 1976.
2. Solid Waste Engineering – Principles and Managements Issues, G. Techbanoglous, H. Theisen and Elliasen, Mc-Graw Hill Inc., 1972.
3. Water Supply for Rural Areas and Small Communities, Wagner E. G. and Lanoik J.N; Geneva, WHO Publication, 1989
4. Solid waste Engineering, Principles and management issues, G. Techbanoglous, Elliasen; Mc-Graw Hill Book Co.1985
5. Solid waste Management in developing Countries, Bhide A.D and Sudaresan B.B; INSDOC, New Delhi, 1983.
6. Solid Waste Management, D. Joseph Hagerty, Joseph L. Pavoni& John E. HeerJr.;VanNorstrand ,Van Nostrand Reinhold, New York 1973.
7. Handbook of solid waste Management, Frank Kreith; 2nd edition, Mc-Graw Hill Inc. 2002
8. Management of Solid Waste in Developing Countries, Frank Flintoff; 2ndEdn, WHO publication, 1984.

PROGRAM ELECT. – III (2SFEE3) : (2) BIOREMEDIATION: PRINCIPLES AND APPLICATION

Course Objectives:

1. To provide knowledge regarding bioremediation and bio remedial practices those are being carried out.
2. To provide knowledge regarding natural and programmed bioremediation.
3. To study different types of bioremediation in detail.

Course Outcomes:

At the end of the course the student will be able to:

1. Acquire detail knowledge regarding bio remedial practices.
2. Understand solid and slurry phase bioremediation (composting, land farming, slurry bioreactors and lagoons).
3. Explain Genetic Engineering and Bioremediation.

SECTION A

Unit I : Introduction to biotransformation, biodegradation and bioremediation, history of bioremediation, xenobiotics and their structures and persistence in the environment, in situ and ex situ bioremediation technologies and their merits and demerits.

Unit II : Bio remedial practices. An overview of the current bio remedial practices and its application, factors affecting bioremediation (physical, chemical and biological), bio stimulation and bio augmentation, bio concentration and bio magnifications.

Unit III : Natural and programmed bioremediation. Inducible and degrading enzymes and their roles, Roles of electron donors and acceptors in bioremediation, anaerobic and aerobic bioremediation processes, application of bioinformatics in bioremediation.

SECTION B

Unit IV : Types of bioremediation Solid and slurry phase bioremediation (composting, land farming, slurry bioreactors and lagoons), liquid phase bioremediation, bioventing, soil-vapour extraction(SVE) and treatment.

Unit V : Genetic Engineering and bioremediation. Phytoremediation Concept of phytoremediation, roles of phytochelatins and chemicals secreted by the plant roots, phytoremediation with trangemic plants, fungal and algal bioremediation, merits and demerits of phytoremediation, Types of phytoremediation systems.

Unit VI : Regulations of GM organisms in India,Biosensors and their applications in bioremediation.

Recommended Books:

1. Baker H. and Herson D.S. Bioremediation, McGraw Hill, 1994
2. Eweis J.B., Ergas S.J., Chang D.P.Y. and Schroeder E.D., Bioremediation Principles, McGraw Hill, 1998.

PROGRAM ELECTIVE – III (2SFEE3) : (3) SOFT COMPUTING SKILLS

Course Objectives:

1. To study the need for soft computing techniques.
2. To Learn Artificial Neural Networks (ANN) and its applications.
3. To study different types of computing techniques and their applications in civil engineering.

Course Outcomes:

At the end of the course the student will be to:

1. Explain the different components of soft computing.
2. Gain Knowledge regarding fuzzy set operations and fuzzy relations.
3. To apply Evolutionary computing, Genetic algorithm and Hybrid soft computing techniques.

SECTION A

Unit I : Need for soft computing techniques, components of soft computing.

Unit II : Artificial Neural Networks (ANN), Types of ANN, Learning algorithms.

Unit III : Applications of ANN, Information and uncertainty, Chance versus ambiguity.

SECTION B

Unit IV : Classical sets and fuzzy sets, Logic and reasoning, Fuzzy set operations and fuzzy relations.

Unit V : Membership Functions, Fuzzy Systems, Decision Making with Fuzzy Information, Fuzzy Classification and Pattern Recognition, Neuro-Fuzzy Systems.

Unit VI : Evolutionary computing, Genetic algorithm, Hybrid soft computing techniques, Applications in Civil Engineering.

Recommended Books:

1. Haykin, Neural Networks: A Comprehensive Foundation, Prentice Hall India, New Delhi, 2008
2. Jang, J.R, Sun Chuen-tsai, and MizutaniEiji, Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, PHI Learning, 2009 Rajasekaran, S., and Vijayalakshmi Pai, G.A., Neural Networks, Fuzzy Logic and Genetic Algorithms – Synthesis and Applications, Prentice-Hall India, New Delhi, 2003
3. Sivanandam, S N and S N Deepa, Principles of Soft Computing, Wiley India, 2013
4. Karray, Fakhreddin O. and Clarence De Silva, Soft Computing and Intelligent Systems Design – Theory, Tools and Applications, Pearson Education Ltd., 2013

PROGRAM ELECTIVE – IV(2SFEE4) : (1) INDUSTRIAL WASTE WATER TREATMENT

Course Objectives:

1. To impart knowledge on composition treatment and effective disposal of industrial effluents.

Course Outcomes:

At the end of the course the student will be able to:

1. Understand and explain the theories and systems of industrial effluent treatment and disposal.
2. Have an outlook on industrial effluent management with reference to specific industry.

SECTION A

Unit I : Problem of Industrial Waste Water:

Variation in quality and quantity of industrial waste water. Effects of discharge of industrial waste water on streams; land and municipal sewers. Benefits of water pollution control by doing treatment of industrial waste.

Unit II : Indian standards for discharge of treated waste water on land, into municipal sewer and natural water courses.

Sampling procedure. Experimental evaluation of physico-chemical or biological treatment methods for treatment of the wastewater.

Unit III : Approaches to minimization of problem of industrial waste water, Good house-keeping, equalization, neutralization, precipitation, mixing of different effluent streams, recycle of effluent streams, process modifications in terms of raw materials or chemicals used general approach to planning of industrial waste water treatment and disposal.Cleaner Technologies of production for waste minimization.

SECTION - B

Unit IV : Different aspects and choices of various alternatives such as:

1) Treating different effluent streams separately.
2) Treating different streams jointly after mixing them partly or fully.
3) Including/excluding domestic waste along with the industrial waste.

General approach for handling and treatment of industrial waste water with following special characteristics.

Unit V : Shock loads, presence of colours, toxic metal/ions, refractory substances, e.g. A B S and other detergents, growth inhibiting substances such as insecticides, waste rich in nutrients (N.P.K. etc.), waste rich in oil & grease, high suspended solids, high BOD, high temperature, acidity, alkalinity etc.

Unit VI : Experimental evaluation of physico-chemical or biological treatment processes for treatment of the waste water.

Process line diagrams, characteristics and treatment of industrial waste of: Pulp and paper, textile, tannery, food, Canings, sugar mill, distillery,dairy, pharmaceutical, electroplating etc. industries.

Recommended Books:

1) Waste Water Treatment, Disposal and Reuse-Mctcalf and Eddy.
2) Pollution Control in Process Industries – S. P. Mahajan.
3) Liquid Waste of Industry – Theory, Practices and Treatment Nemcrow.
4) Industrial Water Pollution Control- W. W. Eekenfelder.
5) Natural Systems for Waste Management and Treatment – S.C. Reed, E.J. Middlebrooks, R. W. Crites.
6) The Treatment of Industrial Waste – Purse Lievre E.B.
7) Water Quality Management by W.W. Eckenfelder
8) Biological Treatment of Waste Waters: W.W. Enkenfelder

PROGRAM ELECTIVE – IV (2SFEE4) : (2) ENVIRONMENTAL MANAGEMENT AND AUDITING

Course Objectives:
1. To study the principles of Environmental Management.
2.To study the policy and legal aspects of Environmental Management.
3.To provide knowledge regarding Environmental Management System Standards.

Course Outcomes:
At the end of the course the student will be able to:
1. Acquire knowledge regarding goals, need for sustainable development, tools, etc. of Environmental Management.
2. Understand the Policy and Legal Aspects of EM.
3. Gain knowledge regarding Life Cycle Assessment (LCA) and Environmental Management System Standards.

SECTION - A

Unit I : Principles of Environment Management: Introducing Environmental Management (EM), Definition and scope, Goals of EM, Need for EM, Need for sustainable development, EM tools, Participants in EM, Existing users, Groups seeking change, Groups with little control, The public, Facilitators, Controllers,

Unit II : Ethics and the Environment,The philosophy of Aldo Leopold, Factors that necessitate environmental ethics, International Environmental Movement, Environmental Concerns in India

Unit III : Policy and Legal Aspects of EM: Introduction to Environmental Policies, Economics and environmental policies, Industries and environmental policies, Agriculture and environmental policies, Ecosystem and environmental policies, Environmental policy instruments (EPI), Environmental Policies and Programmes in India, Forest conservation activities, NGO movements for environmental protection in India, Environmental Laws and Legislations, Private and Public law, Principles of international law, Indian Environmental Laws, International institutions, Key international treaties, Objectives and principles of legislation, Environmental Legislations in India, Evolution of Indian Legislations, Constitution of India, Union Government initiatives

SECTION – B

Unit IV : Environmental Auditing: Introduction to Environmental Auditing (EA), Principles of auditing, Objectives and scope, Responsibilities, resources and procedures within the audit records from the audit program, monitoring and reviewing the audit program, Types of environmental audits, General Audit Methodology, Basic structure of EA, General steps in EA procedure, Elements of Audit Process, What to audit, Who should audit, Why an audit, How to audit, Waste Audits and Pollution Prevention Assessments, EA in Industrial Projects, Liability Audits and Site Assessment, Auditing of EMS, Audit objectives, roles and responsibilities, Scoping and review, Preparing the audit(start, setting objectives, scope and audit criteria, determining the feasibility audit, selection of the audit team to establish initial contact with the audited organization, document review, preparation of the audit on the spot), Implementation of on-site audit, Preparation, approval and distribution of messages, Resolution of disagreements, corrective and preventive actions, competence and evaluation of auditors, Conducting the audit, Content of audit report

Unit V : Life Cycle Assessment (LCA): Life cycle assessment and its purpose, Evolution of Life Cycle Assessment, Stages in LCA of a Product, A Code of Good Conduct for LCA, Procedures for LCA, Defining the goal and scope, Analyzing the inventory, Assessing environmental impact, Evaluating environmental profiles, Different Applications of LCA, Private sector applications, Governmental application.

Unit VI : Environmental Management System Standards: Environmental Management Systems (EMS), Core elements of EMS, Benefits of EMS, Certification body assessments of EMS, Documentation for EMS, EMS Standards: ISO 14000-Evolution, Principles and structure, ISO 14000 supporting systems, EMS specification standards: ISO 14001, Implementation of EMS Conforming to ISO 14001, Benefits of Implementing ISO 14001: An Indian Scenario, OHSAS 18001 and its comparison with ISO 14001 and ISO 9001, BS 18004:2008

Recommended Books:
1. Environmental Science and Management, Abhijit Mallick.
2. The ISO 14000 EMS Audit Handbook, Greg Johnson.
3. Corporate Environmental Management Systems and Strategies, Richard Welford,Universities Press (I) Ltd., Hyderabad, 1996.

PROGRAM ELECTIVE – IV (2SFEE4) : (3) ENVIRONMENTAL SYSTEMS MODELLING AND STATISTICS

Course Objectives:

1. To provide knowledge regarding the Models for environmental systems.
2. To study Global radiation balance and climatic changes, Transport and fate of pollutant in aquatic systems.
3. To study the Stochastic Processes in the Environment.
4. To study Sampling and determine the sample size.

Course Outcomes:

At the end of the course the student will be able to:

1. Acquire knowledge regarding air quality models.
2. Explain the Applications of public domain models and software.
3. Make the use of Computational methods in environmental modelling.
4. Calculate the Sampling frequency and duration.

SECTION – A

Unit I : Models for environmental systems Definition; Classification; Examples of models for environmental systems.
Introduction to air quality models; Meteorology; Atmospheric stability and turbulence; Gaussian plume model and modifications.

Unit II : Numerical models, Urban diffusion models, Calibration and sensitivity analysis; Applications of public domain models, and software.

Unit III : Global radiation balance and climatic changes, Transport and fate of pollutant in aquatic systems; Introduction to river, estuarine and lake hydrodynamics; Stratification and eutrophication of lakes; Dissolved oxygen model for streams; Temperature models, Transport and fate of pollutants in soils and ground water.

SECTION – B

Unit IV : Utility of environmental models for forecasting, Computational methods in environmental modelling.
Unit V : Stochastic Processes in the Environment: Probability concepts; Conditional probability and Bayes theorem. Environmental Data Analysis and QA/QC: Descriptive statistics; Averaging times.

Unit VI : Sampling and analysis Sample size determination; Sampling frequency and duration; Measurement uncertainty; Accuracy testing and precision; Sample and dynamic blanks; Error propagation; Linear least-squares regression; Trend analysis; Non-parametric statistics. Experiment Design and Hypothesis: Testing: Factorial design of experiments; Confidence intervals; Equality of means; T-test; Analysis of variance (ANOVA); F-test; Significance of factor effects and their interactions.

Recommended Books:

1. Environmental Statistics and Data Analysis, Wayne R. Ott, CRC Press, 1994.
2. Environmental statistics: Methods and Applications, V Barnett, John Wiley & Sons Ltd, 2004.
3. Environmental Statistics with S-Plus, Steven P. Millard, Nagaraj K. and Neerchal,CRC Press 2001.
4. Principles of Surface Water Quality Modelling and Control, R. V. Thomann and J. A. Muller, Harper International edition, 1987.
5. Water Quality, G. Tchibangolous, E. D. Schroedere, Addision Wesley Publishing Co. Massachusettes, 1987.
6. Atmospheric Chemistry and Physics, J.H. Seinfeld, and S.N, Pandis, John Wiley and Sons Inc, New York, 1998.
7. Experimental Modelling, J.L. Schnoor, Inter Sc. Publications, 1996.
8. Fundamentals of Air Pollution, R.W. Boubel, and A.C Stern,Academic Press, 1994.

AUDIT COURSES – II (2SFEE5) : (1) DISASTER MANAGEMENT

Course Objectives:

1. To demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. To be able to evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. To develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

Course Outcomes:

At the end of the course the students will be able to:

1. Critically understand the strengths and weaknesses of disaster management approaches,
2. Planning and programming in different countries, particularly their home country or the countries they work in.

SYLLABUS

UNIT I :Introduction Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II :Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.
Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Manmade disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT III :Disaster Prone Areas in India: Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

UNIT IV: Disaster Preparedness and Management: Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT V :Risk Assessment; Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT VI : Disaster Mitigation: Meaning, Concept And Strategies Of Disaster Mitigation, EmergingTrends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Recommended Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep & Deep Publication Pvt. Ltd., New Delhi.

AUDIT COURSES – II (2SFEE5) : (2) PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objectives:

1. To learn to achieve the highest goal happily.
2. To become a person with stable mind, pleasing personality and determination.
3. To awaken wisdom in students.

Course Outcomes:

At the end of the course the students will be able to:

1. Acquire knowledge regarding the Study of Shrimad-Bhagwad- Geeta that will help them in developing his personality and achieve the highest goal in life.
2. Lead the nation and mankind to peace and prosperity.
3. Study Neetishatakamthat will help in developing their versatile personality.

SYLLABUS

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)
- Approach to day to day work and duties.
- Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.
- Statements of basic knowledge.
- Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad BhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Recommended Books:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram Publication
2. Department), Kolkata
3. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P. Gopinath,
4. Rashtriya Sanskrit Sansthanam, New Delhi.

AUDIT COURSES – II (2SFEE5) : (3) STRESS MANAGEMENT BY YOGA

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress.

Course Outcomes:

At the end of the course the students will be able to**:**

1. Develop healthy mind in a healthy body thus improving their social health also.
2. Improve their efficiency.

SYLLABUS

- Definitions of Eight parts of yog (Ashtanga)
- Yam and Niyam

Do`s and Don'ts's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

- Asan and Pranayam

i) Various yog poses and their benefits for mind & body

ii) Regularization of breathing techniques and its effects-Types of pranayam

References :

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.

CORE LAB III (2SFEE6) : ENVIRONMENTAL ENGINEERING LAB - 3

Design any one of the following:

1) Design of Water Treatment Processes.
2) Design of Sewage Treatment Processes.
3) Design of plumbing for multistory building.
4) Design of sewerage systems for small town/village.

CORE LAB IV (2SFEE7) : ENVIRONMENTAL ENGINEERING LAB - 4

Software based practical on treatment process design and modeling for pollution assessment and control.

MINI PROJECT(2SFEE8)

Mini project is based on the syllabus of Environmental Engineering.

SEMESTER THIRD

PROGRAM ELECTIVE V (3SFEE1): (1) ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT

Course Objective:

1. To provides a detailed insight into the Indian environmental legislation aspects including National Environmental Policy, legal framework, Gand various Acts related to environmental pollution, Prevention and control.
2. Explains the process of impact assessment; and deals with various methodologies. It reviews few case studies on EIA.

Course Outcomes:

At the end of the course student will be able to:

1. Explain the National Environmental policy and Legal framework related to environmental aspects.
2. List and Identify various Indian Environmental Acts in vogue, Amendments, modifications and notifications. Describe the Role of Tribunal.
3. Discuss the concept of Carrying Capacity; Environmental Impact Assessment studies for various developmental activities. Defines objectives, types and limitations of EIA. Lists and describes various EIA methodologies.
4. Describe the scope of EIA along with the framework. Propose the need for public participation in EIA. Explain importance of attributes, Standards and Value functions for various parameters. Apply predictive models.

SECTION - A

Unit I : Development and Environment, need for EIA, concept of EIA, elements of EIA, nature of impacts – primary, secondary, tertiary, short-term, long-term, local and regional, reversible & irreversible impacts.

Unit II : Overview of impacts – directly & indirectly measurable impacts w.r.to air, noise & water. Screening and scoping in EIA, terms of reference for conducting EIA, methodologies of EIA-checklists, matrices, overlays, cost benefit analysis, & networks.

Unit III : Framework of EIA – scope of EIA, baseline data collection, prediction of impacts, evaluation of impacts, battelle environmental evaluation system, environmental quality monitoring.

SECTION - B

Unit IV : Environmental legislation – basic concepts, critical issues, civil liability, various enactment and their provisions – Water Act (1974,1988), Air Act (1981, 1988), Environmental Protection Act 1986, Role of State & Central boards of pollution control, local Govt., social action groups.

Unit V : Environmental Audit – definition, concept of EA, types of environmental audit, benefits of environmental audit, scope & objectives, environmental statement, procedural aspects of conducting environmental audit, pre-audit phase, on-site audit phase & post-audit phase.

Sustainable development & environmental management, carrying capacity based developmental planning process, concept of carrying capacity, assimilative and supportive capacity, Environmental Management in India.

Unit VI : Resource Management Types of resources - terrestrial (soil) resources, minerals, plants & animals (biotic) resources, marine, fresh water, air & bioenergy resources, resource utilization-renewable and non-renewable resources, optimal use of resources, depletion of resources – causes & effects.

Recommended Books:

1) Environmental Impact Assessment: Rau &Woofes.
2) Environmental Impact Assessment: W.F. Canter, McGraw Hill.
3) Proceedings of Indo-British Workshop on EIA of Petrochemical. Industries and Environmental Audit, Jan. 1994, IAEM, Nagpur.
4)Handbook on Pollution Control Acts, Central Pollution Control Board, New Delhi.
5) The New Environmental Age by R. K. Sapra, S. Bhardwaj, Ashish Pub. House, New Delhi.

PROGRAM ELECTIVE – V (3SFEE1):

(2) WATER SUPPLY AND WASTE WATER COLLECTION SYSTEMS

Course Objectives:

1. To study the Water transmission systems and water distribution systems.
2. To provide knowledge regarding the Design of rising mains.
3. To study the different types of sewer system.
4. To study Optimization Techniques Analytical solutions using different methods.

Course Outcomes:

At the end of the course the student will be able to:

1. Analyse the flow in closed and open pipe networks using various methods.
2. Acquire knowledge regarding the requisites for sewerage system design.
3. Find out the solutions by Calculus, Lagrange Multiplier method, Linear programming Optimization of water distribution systems including branching, water hammer, causes and prevention.
4. Carry out the Cost analysis and optimization of sewer system.

SECTION A

Unit I : Hydraulics of water mains: Water transmission systems and water distribution systems, analysis, different methods Relaxations methods, method of section, Equivalent pipe method, Maintenance of distribution systems.

Unit II : Design of rising mains, Analysis of flow Analysis of flow in closed and open pipe networks using various methods, Hardy Cross Method, Newton Raphson Method, Linear Method, CPM method, Distribution network, Pumps and Pumping station. Design of pump and pumping station.

Unit III : Types of sewer system , requisites for sewerage system design, Flow through sewers Hydraulics of sewers, Self-cleansing velocity, Sewer shape-their usefulness, sewer invert drop, Design of sewerage networks.

SECTION B

Unit IV : Pumps and pumping station: Requirement analysis of pumps, Design of pumping mains.

Unit V : Optimization Techniques Analytical solutions by Calculus, Lagrange Multiplier method, Linear programming Optimization of water distribution systems including branching, water hammer, causes and prevention.

Unit VI : Cost analysis and optimization of sewer system, Principles of Reliability analysis.

Recommended Books:

1. Watershed Hydrology, Peter E. Black, Prentice Hall, 1991.
2. Water Resources Systems, Planning and Management, R.N. Chaturvedi, New Delhi : Tata McGraw-Hill, 1987
3. Bhave P. R. And Gupta R, Analysis of Water Distribution Networks, Narosa Publishing Co., New Delhi (2006).
4. Bhave P.R, Optimal design of water distribution networks, Narosa Publishing Co., New Delhi (2003).
5. Engineering Optimization: Theory and Practice Book by S. S. Rao

PROGRAM ELECTIVE – V(3SFEE1):

(3) REMOTE SENSING AND GIS IN ENVIRONMENTAL ENGINEERING

Course Objectives:

1. To provide information about Surface-Water Hydrologic Data, Spatial techniques for Surface-Water Hydrology Modelling.
2. To study the Geospatial techniques for planning and design of Water-Supply.
3. To provide knowledge regarding Applications of Geo informatics for spatial management of resources.
4. To study the integrated applications using various technologies within Geo informatics.

Course Outcomes:

At the end of the course the student will be able to:

1. Design GIS-Based Wastewater Collection System Design.
2. Design GIS-Based Decision-Support Systems for Wastewater and Storm water Systems.
3. Gain knowledge regarding Geospatial technologies for Water Resources Monitoring and Forecasting.
4. Explain the Applications of Remote Sensing and Geographic Information Systems in Wildlife Mapping and Modelling.

SECTION A

Unit I : Surface-Water Hydrologic Data, Spatial techniques for Surface-Water Hydrology Modeling, Surface-Water Hydrology Models, ArcSWAT model and its applications; Groundwater Data, Ground water Models and spatial techniques for Groundwater Modeling and Visualization, The ArcHydro Data Model.

Unit II : Geospatial techniques for planning and design of Water-Supply, Geospatial techniques for planning and design of solid waste collection and Irrigation Systems, Spatial Database Development for Wastewater and Storm water Systems, GIS-Based Wastewater Collection System Design and Management Applications, GIS-Based Decision-Support Systems for Wastewater and Storm water Systems.

Unit III : Geospatial technologies for Water Resources Monitoring and Forecasting; Spatial Decision-Support Systems in River Basin Management; Spatial systems for floodplain mapping and management. Spatial techniques for Water Quality Monitoring and Modeling, GIS for Water Quality Database Development.

SECTION – B

Unit IV : Applications of Geoinformatics for spatial management of resources: Run-off estimations, infiltration characteristics, groundwater potential and recharge characteristics, Watershed management, watershed prioritization, Sediment yield estimation, reservoir capacity studies, transportation design and planning, Spatial analyses for Environment Impact assessment, Monitoring and feedback, Natural indices, Concept of E-Governance using Geoinformatics, web GIS.

Unit V : Integrated applications using various technologies within Geoinformatics; methods and approach. Real time and temporal analysis using Geoinformatics. Multidisciplinary applications of Geoinformatics; integration of various segments. Geoinformatics for resources management and utilities management.

Unit VI : Taxonomy of Environmental Models in the Spatial Sciences. Geographic Data for Environmental Modeling and Assessment. Applications of Remote Sensing and Geographic Information Systems in Wildlife Mapping and Modeling. Land Use Planning and Environmental Impact Assessment Using Geographic Information Systems.

Recommended Books:

1. Lynn E. Johnson, Geographic Information Systems in Water Resources Engineering, CRC Press, 2008.
2. Praveen Kumar, Mike Folk, Momcilo Markus and Jay C. Alameda, Hydroinformatics: Data Integrative Approaches in Computation, Analysis, and Modeling, CRC Press, 2005. Allan Brimicombe, GIS, Environmental Modeling and Engineering, Second Edition, CRC Press, 2009. 4. Andrew Skidmore (Editor, Environmental Modelling with GIS and Remote Sensing, CRC Press), 2002

OPEN ELECTIVE – 1 (3SFEE2) : (1) BUSINESS ANALYTICS

Course Objectives:

1. To understand the role of business analytics within an organization.
2. To analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Course Outcomes:

At the end of the course the student will be able to :

1. Demonstrate knowledge of data analytics.
2. Demonstrate the ability to think critically in making decisions based on data and deep analytics.
3. Demonstrate the ability to use technical skills in predicative and prescriptive modelling to support business decision-making.
4. Demonstrate the ability to translate data into clear, actionable insights.

SECTION A

1.Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics.

2.Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

3. Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression, Important Resources, Business Analytics Personnel, Data and models for
Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

4. Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.
Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

5.Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

6. Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Recent Trends in : Embedded and collaborative business intelligence,
Visual data recovery, Data Storytelling and Data journalism.

Recommended Books:

1.Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2.Business Analytics by James Evans, persons Education.

OPEN ELECTIVE – 1 (3SFEE2) : (2) INDUSTRIAL SAFETY

Course Objectives:

1. To provide knowledge regarding industrial safety.
2. To study the fundamentals of maintenance engineering.
3. To study the fundamentals of maintenance engineering and the concept of fault tracing.

Course Outcomes :

At the end of the course the student will be able to:

1. Acquire detailed knowledge regarding accidents, causes, types, results and control, mechanical and electrical hazards in industries.
2. Understand the aim of maintenance engineering and the primary and secondary functions and responsibility of maintenance department.
3. To perform periodic and preventive maintenance of the industries.

SYLLABUS

1. Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, Safety color codes. Fire prevention and firefighting, equipment and methods.

2. Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

3. Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

4. Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

5. Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Recommended Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

OPEN ELECTIVE – 1 (3SFEE2) : (3) OPERATION RESEARCH

Course Objectives:

1. To study Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis and Inventory Control Models.
2. To study Formulation of a LPP and Nonlinear programming problem.
3. To make one understand the scheduling and sequencing of different models.

Course Outcomes :

At the end of the course the student will be able to:

1. Find Graphical solution by revised simplex method - duality theory - dual simplex method - sensitivity analysis parametric programming.
2. Evaluate Kuhn-Tucker conditions min using cost flow problem and max flow problem using CPM/PERT.
3. Schedule and sequence single server and multiple server models and also deterministic inventory models.

SYLLABUS

1. Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

2. Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

4. Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

4.Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

5.Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Recommended Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008.
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008.
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009.
5. Pannerselvam, Operations Research: Prentice Hall of India 2010.
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010.

OPEN ELECTIVE – 1 (3SFEE2) : (4) COST MANAGEMENT OF ENGINEERING PROJECTS

Course Objectives:

1. To introduce and overview the Strategic Cost Management Process Cost concepts in decision-making.
2. To study the concept of project in detail.
3. To study Cost Behaviour and Profit Planning Cost Behaviour and Profit Planning Marginal Costing.
4. To understand the Quantitative techniques for cost management.

Course Outcomes:

At the end of the course the student will be able to:

1. Understand Objectives of a Costing System.
2. Explain project execution as conglomeration of technical and nontechnical activities and detailed engineering activities.
3. Learn Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

SYLLABUS

1. Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

2. Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

3. Cost Behavior and Profit Planning Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of divisional profitability pricing decisions including transfer pricing.

4. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory

Recommended Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

OPEN ELECTIVE – 1 (3SFEE2): (5) COMPOSITE MATERIALS

Course Objectives:

1. To introduce the concept of composite materials.
2. To study reinforcements in detail.
3. To study the Manufacturing of Metal Matrix Composites and Polymer Matrix Composites**.**

Course Outcomes :

At the end of the course the student will be able to:

1. Understand the advantages and application of composite, functional requirements of reinforcement and matrix and effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.
2. Acquire knowledge regarding the properties and applications of whiskers, particle reinforcements and the mechanical behaviour of composites.
3. Know the Laminar Failure Criteria that includes strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hydrothermal failure.

SYLLABUS

1. Introduction: Definition, Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

2. Reinforcements: Preparation-layup, curing, properties and applications of glass fibres, carbon fibres, Kevlar fibres and Boron fibres. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

3. Manufacturing of Metal Matrix Composites: Casting, Solid State diffusion technique, Cladding, Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration, Liquid phase sintering. Manufacturing of Carbon, Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

4. Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs, hand layup method, Autoclave method, Filament winding method, Compression moulding, Reaction injection moulding. Properties and applications.

5. Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hydrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Reference Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007
1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.
5.

OPEN ELECTIVE – 6 (3SFEE2) : (F)WASTE TO ENERGY

Course Objectives:

1. To introduce the concept of Energy from Waste.
2. To study the concept of Biomass Pyrolysis, Biomass Gasification, and Biomass Combustion.
3. To understand Technology and status of bio-energy system.

Course Outcomes:

At the end of the course the student will be able to:

1. Classify the different types of wastes.
2. Acquire knowledge regarding the different types of systems used for the conversion of energy from wastes.
3. Design different systems for energy conversion.

SYLLABUS

1. Introduction to Energy from Waste: Classification of waste as fuel, Agro based, Forest residue, Industrial waste, MSW, Conversion devices, Incinerators, gasifier, digesters.

2. Biomass Pyrolysis: Pyrolysis, Types, slow fast, Manufacture of charcoal, Methods, Yields and application, Manufacture of pyrolytic oils and gases, yields and applications.

3. Biomass Gasification: Gasifier, Fixed bed system, Downdraft and updraft gasifiers, Fluidized bed gasifiers, Design, construction and operation, Gasifier burner arrangement for thermal heating, Gasifier engine arrangement and electrical power, Equilibrium and kinetic consideration in gasifier operation.

4. Biomass Combustion: Biomass stoves, Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation, Operation of all the above biomass combustors.

5. Technology and status - Bio energy system, Design and constructional features, Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, Direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, Types of biogas Plants, Applications, Alcohol production from biomass, Bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

Recommended Books:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

SEMINAR & DISSERTATION (3SFEE3) PHASE– I

Student has to select a topic for dissertation, carry out literature review, find the literature gap, carry out 40% or more work on dissertation topic and submit the report and deliver the seminar based on it.

SEMESTER FOURTH

SEMINAR & DISSERTATION (4SFEE1) PHASE –II

Student has to carryout remaining dissertation work on the selected dissertation topic and submit the report. Seminar shall be delivered on the dissertation submitted. Marks shall be based on your work, Seminar and Viva-Voce on dissertation.

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NOTIFICATION

No. 26 /2021 Date : 25/02/2021

Subject : Chances / Equivalence & Absorption Schemes for the Old Course failure students of M.E. (Environmental Engg.) (P.T. Semester Pattern C.G.S.) in the Faculty of Science & Technology from the academic session 2020-21.

It is notified for general information of all concerned that the authorities of the University have accepted the Chances / Equivalence & Absorption Schemes for the Old Course failure students of Semester I to IV of M.E. (Environmental Engg.) (P.T. Semester Pattern C.G.S.) in the Faculty of Science & Technology to be implemented from Winter-2020 examinations and onwards in phase wise manner as mentioned in the following table.

Schemes of Equivalence & Absorption / Chances for Old Course failure students of M.E. (P. T. C.G.S.) (Three Year Semeser Pattern)

TABLE

Sr No	Old Course Sub. Code	Old Course Subject (P.T. CGS)	chances to be given	Equivalent New Subject Code (CGS)	Equivalent New Subject after exhausting Chances
1	2	3	4	5	6
1	1SCEE1	**Sem. – I (w.e.f. Winter-2020)** Environmental Sciences & Chemistry	Chances up to Winter - 2021	1SFEE2	Environmental Sciences & Chemistry
2	1SCEE2	Environmental Microbiology	Chances up to Winter - 2021	1SFEE1	Environmental Microbiology
3	2SCEE1	**(w.e.f. Summer-2021)** Watershed Management	Chances up to Summer – 2022	1SFEE3 (1) Progr.Elect.-I	Watershed Management
4	2SCEE2	Advanced Water Treatment	Chances up to Summer - 2022	2SFEE1	Advanced Water Treatment Technology
5	2SCEE3	Advanced Waste Water Treatment	Chances up to Summer - 2022	2SFEE2	Advanced Waste Water Treatment Technology
6	3SCEE1	**(w.e.f. Winter-2021)** Envirronmental Impact Assess-ment & Management	Chances up to Winter - 2022	3SFEE1 (1) Progr.Elect-V	Environmental Impact Assess-ment & Management
7	3SCEE2	Air Pollution & Control	Chances up to Winter - 2022	1SFEE4 Progr.Elect-II	Air Pollution
8	4SCEE1	**(w.e.f. Summer-2022)** Industrial Waste Water Treatment	Chances up to Summer – 2023	2SFEE4 (1) Progr.Elect.-IV	Industrial Waste Water Treatment
9	4SCEE2	Envirronmental Sanitation & Waste Water Management	Chances up to Summer - 2023	2SFEE3 (1) Progr.Elect.-III	Solid & Biomedical Waste Management
10	4SCEE3	**Elective** : i)Hazardous Waste Management iv)Remote Sensing & GIS in Environmental Engg.	i)chances up to Summer - 2023 iv) Chances up to Summer - 2023	i)1SFEE3 (3) Progr.Elect.-I iv) 3SFEE1 (3) Progr.Elect.-V	i)Hazardous Waste Management iv) Remote Sensing & GIS in Environmental Engg.

Sd/-
(Dr.T.R.Deshmukh)
Registrar
Sant Gadge Baba Amravati University