ANNAMALAI UNIVERSITY

Annamalainagar

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

M.E. Environmental Engineering

Choice Based Credit System (CBCS)
(Full-Time)

HAND BOOK

Regulations - 2023

ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

M.E. (Two -Year Full Time) DEGREE PROGRAMME (CBCS)

REGULATIONS - 2023

1. Conditions for Admission

Candidates for admission to the first year of the four-semester **M.E Degree Programme in Engineering** shall be required to have passed B.E / B.Tech degree of Annamalai University or any other authority accepted by the syndicate of this University as equivalent thereto. They shall satisfy the conditions regarding qualifying marks and physical fitness as may be prescribed by the Syndicate of the Annamalai University from time to time.

2. Branches of Study in M.E

The Branch and Eligibility criteria of Programmes are given in Annexure

3. Courses of Study

The courses of study along with the respective syllabi and the scheme of Examinations for each of the M.E Programmes offered by the different Departments of study in the Faculty of Engineering and Technology are given in Annexures of the respective Departments.

4. Choice Based Credit System (CBCS)

The curriculum includes Program Core, Program Electives and Open Electives, Mandatory Learning Courses and Audit Courses in addition to the Thesis. Each semester curriculum shall normally have a blend of theory and practical courses.

5. Assignment of Credits for Courses

Each course is normally assigned one credit per hour of lecture / tutorial per week and 0.5 credit for one hour of laboratory or project or industrial training or seminar per week. The total credits for the Programme will be **68**.

6. Duration of the Programme

A student of M.E Programme is normally expected to complete in four semesters for the full-time but in any case not more than four years from the date of admission.

7. Registration for Courses

A newly admitted student will automatically be registered for all the courses prescribed for the first semester, without any option. Every other student shall submit a completed registration form indicating the list of courses intended to be credited during the next semester. This registration will be done a week before the last working day of the current semester. Late registration with the approval of the Dean on the recommendation of the Head of the Department along with a late fee will be done up to the last working day. Registration for the Thesis Phase - I and Phase-II shall be done at the appropriate semesters.

8. Electives

8.1 Program Electives

The student has to select two electives in first semester, another two electives in the second semester and one more in the third semester from the list of Program Electives.

8.2 Open Electives

The student has to select two electives in third semester from the list of Open Electives offered by the Department and / or other departments in the Faculty of Engineering and Technology.

9. Industrial Project

A student may be allowed to take up the one program elective and two open elective courses of third semester (Full Time program) in the first and second semester, to enable him/her to carry out Project Phase-I and Phase-II in an industry during the entire second year of study. The condition is that the student must register those courses in the first semester itself. Such students should meet the teachers offering those elective courses themselves for clarifications. No specific slots will be allotted in the time table for such courses.

10. Assessment

10.1 Theory Courses

The break-up of continuous assessment and examination marks for theory courses is as follows:

First assessment (Mid-Semester Test-I)	:	08 marks
Second assessment (Mid-Semester Test-II)	:	12 marks
Third Assessment	:	05 marks
End Semester Examination	:	75 marks

10.2 Practical Courses

The break-up of continuous assessment and examination marks for Practical courses is as follows:

First assessment (Test-I)	:	15 marks
Second assessment (Test-II)	:	15 marks

Maintenance of record book : 10 marks

End Semester Examination : 60 marks

10.3 Thesis Work

The thesis Phase-I will be assessed for 40 marks by a committee consisting of the Head of the Department, the guide and a minimum of two members nominated by the Head of the Department. The Head of the Department will be the chairman. The number of reviews must be a minimum of three per semester. 60 marks are allotted for the thesis work and viva voce examination at the end of the third semester. The same procedure will be adopted for thesis Phase II in the fourth semester.

10.4 Seminar / Industrial Training

The continuous assessment marks for the seminar / industrial training will be 40 and to be assessed by a seminar committee consisting of the Seminar Coordinator and a minimum of two members nominated by the Head of the Department. The continuous assessment marks will be awarded at the end of the seminar session. 60 marks are allotted for the seminar / industrial training and viva voce examination conducted based on the seminar / industrial training report at the end of the semester.

11. Student Counselors (Mentors)

To help the students in planning their course of study and for general advice on the academic Programme, the Head of the Department will attach a certain number of students to a member of the faculty who shall function as student counselor (mentor) for those students throughout their period of study.

12. Class Committee

For each of the semesters of M.E programmes separate class committees will be constituted by the respective Head of the Departments. The composition of the class committees from first to fourth semesters for Full time will be as follows:

- Teachers of the individual courses.
- A Thesis coordinator (for Thesis Phase - I and II) shall be appointed by the Head of the Department from among the Thesis supervisors.
- A thesis review committee chairman shall be appointed by the Head of the Department
- One Professor or Associate Professor, preferably not teaching the concerned class, appointed as Chairman by the Head of the Department.
- The Head of the Department may opt to be a member or the Chairman.
- All counselors of the class and the Head of the Department (if not already a member) or any staff member nominated by the Head of the Department may opt to be special invitees.

The class committee shall meet three times during the semester. The first meeting will be held within two weeks from the date of class commencement in which the type of assessment like

test, assignment etc. for the third assessment and the dates of completion of the assessments will be decided.

The second meeting will be held within a week after the completion of the first assessment to review the performance and for follow-up action.

The third meeting will be held after all the assessments but before the University semester examinations are completed for all the courses, and at least one week before the commencement of the examinations. During this meeting the assessment on a maximum of 25 marks for theory courses / 40 marks for practical courses, for Industrial Training and for Thesis work (Phase-I and Phase-II) will be finalized for every student and tabulated and submitted to the Head of the Department for approval and transmission to the Controller of Examinations.

13. Temporary Break of Study

A student can take a one-time temporary break of study covering the current semester and / or the next semester with the approval of the Dean on the recommendation of the Head of the Department, not later than seven days after the completion of the mid- semester test. However, the student must complete the entire Programme within the maximum period of **four years.**

14. Substitute Assessments

A student who has missed, for genuine reasons accepted by the Head of the Department, one or more of the assessments of a course other than the end of semester examination may take a substitute assessment for any one of the missed assessments. The substitute assessment must be completed before the date of the third meeting of the respective class committees.

A student who wishes to have a substitute assessment for a missed assessment must apply to the Head of the Department within a week from the date of the missed assessment.

15. Attendance Requirements

The students with 75% attendance and above are permitted to appear for the University examinations. However, the Vice - Chancellor may give a rebate / concession not exceeding 10% in attendance for exceptional cases only on Medical Grounds.

A student who withdraws from or does not meet the minimum attendance requirement in a semester must re-register and repeat the same semester in the subsequent academic years.

16. Passing and Declaration of Examination Results

All assessments of all the courses on an absolute marks basis will be considered and passed by the respective results passing boards in accordance with the rules of the University. Thereafter, the controller of examinations shall convert the marks for each course to the corresponding letter

grade as follows, compute the grade point average (GPA) and cumulative grade point average (CGPA) and prepare the mark sheets.

90 to 100 marks	Grade S‘
80 to 89 marks	Grade A‘
70 to 79 marks	Grade B‘
60 to 69 marks	Grade C‘
55 to 59 marks	Grade D‘
50 to 54 marks	Grade E‘
Less than 50 marks	Grade RA‘
Withdrawn from the Examination	Grade W‘

A student who obtains less than 30 / 24 marks out of 75 / 60 in the theory / practical examinations respectively or is absent for the examination will be awarded grade RA.

A student who earns a grade of S, A, B, C, D or E for a course is declared to have successfully completed that course and earned the credits for that course. Such a course cannot be repeated by the student.

A student who obtains letter grade RA / W in the mark sheet must reappear for the examination of the courses.

The following grade points are associated with each letter grade for calculating the grade point average and cumulative grade point average.

S - 10; A - 9; B - 8; C - 7; D - 6; E - 5; RA – 0

Courses with grade RA / W are not considered for calculation of grade point average or cumulative grade point average.

A student can apply for re-totaling of one or more of his examination answer papers within a week from the date of issue of mark sheet to the student on payment of the prescribed fee per paper. The application must be made to the Controller of Examinations with the recommendation of the Head of the Department.

After the results are declared, mark sheets will be issued to the students. The mark sheet will contain the list of courses registered during the semester, the grades scored and the grade point average for the semester.

GPA is the sum of the products of the number of credits of a course with the grade point scored in that course, taken over all the courses for the semester, divided by the sum of the number of credits for all courses taken in that semester.

CGPA is similarly calculated considering all the courses taken from the time of admission.

17. Awarding Degree

After successful completion of the Programme, the degree will be awarded with the following classifications based on CGPA.

For First Class with Distinction the student must earn a minimum of 68 credits within four semesters from the time of admission, pass all the courses in the first attempt and obtain a CGPA of 8.25 or above.

For First Class, the student must earn a minimum of 68 credits within two years and six months from the time of admission and obtain a CGPA of 6.75 or above.

For Second class, the student must earn a minimum of 68 credits within four years from the time of admission.

The conversion of OGPA/CGPA (from I semester to IV Semester) to the corresponding Percentage of marks may be calculated as per the following formula:

Percentage of marks = (OGPA/CGPA - 0.25) x 10

Where $OOOO/OOOO = \frac{\Sigma\, O_O O O_O}{\Sigma\, O_O}$

O_O Credit hours of a course

OO_O - Grade Point of that course

18. Ranking of Candidates

The candidates who are eligible to get the M.E degree in First Class with Distinction will be ranked on the basis of CGPA for all the courses of study from I to IV semester.

The candidates passing with First Class and without failing in any subject from the time of admission will be ranked next to those with distinction on the basis of CGPA for all the courses of study from I to IV semester.

19. Transitory Regulations

If a candidate studying under the old regulations M.E could not attend any of the courses in his/her courses, shall be permitted to attend equal number of courses, under the new regulation and will be examined on those subjects. The choice of courses will be decided by the concerned Head of the department. However he/she will be permitted to submit the thesis as per the old regulations. The results of such candidates will be passed as per old regulations.

The University shall have powers to revise or change or amend the regulations, the scheme of examinations, the courses of study and the syllabi from time to time.

ANNEXURE

S. No.	Department		Programme (Full Time)	Eligible B.E. / B.Tech Programme
1	Civil Engineering	i	Environmental Engineering	B.E. / B.Tech - Civil Engineering, Civil &Structural Engineering, Environmental Engineering, Mechanical Engineering, Industrial Engineering, Chemical Engineering, Bio Chemical Engineering, Biotechnology, Industrial Biotechnology, Chemical & Environmental Engineering.
		ii	Water resources Engineering & Management	B.E. / B.Tech - Civil Engineering, Civil &Structural Engineering, Environmental Engineering, Mechanical Engineering, Agricutural and irrigation Engineering, Geo informatics, Energy and Environmental Engineering.
2	Civil & Structural Engineering	i	Structural Engineering	B.E. / B.Tech - Civil Engineering, Civil & Structural Engineering.
		ii	Construction Engineering. and Management	
3	Mechanical Engineering	i	Thermal Power	B.E. / B.Tech - Mechanical Engineering, Automobile Engineering, Mechanical Engineering (Manufacturing).
		ii.	Energy Engineering & Management	B.E. / B.Tech - Mechanical Engineering, Automobile Engineering, Mechanical (Manufacturing) Engineering, Chemical Engineering
4	Manufacturing Engineering	i	Manufacturing Engineering	B.E. / B.Tech - Mechanical Engineering, Automobile Engineering, Manufacturing Engineering, Production Engineering, Marine Materials science Engineering,Metallurgy Engineering, Mechatronics Engineering and Industrial Engineering.
5	Electrical	i	Power System	B.E. / B.Tech - Electrical and Electronics Engineering,

	Engineering		Engineering	
6	Electronics & Instrumentation Engineering	i	Process Control & Instrumentation	B.E. / B.Tech - Electronics and Instrumentation Engineering, Electrical and Electronics Engineering, Control and Instrumentation Engineering, Instrumentation Engineering, , Electronics and Communication Engineering,
7	Chemical Engineering	i	Chemical Engineering	B.E. / B.Tech - Chemical Engineering, Petroleum Engineering, Petrochemical Technology
		ii	Food Processing Technology	B.E. / B.Tech - Chemical Engineering, Food Technology,Biotechnology, Biochemical Engineering, Agricultural Engineering.
8	Computer Science and Engineering	i	Computer Science and Engineering	B.E. / B.Tech - Computer Science and Engineering, Computer Science and Engineering (Artificial Intelligence and Machine Learning), Computer Science and Engineering (Data Science), Information Technology, Electronics & Communication Engineering, Software Engineering
9	Electronic & Communication Engineering	i.	Communication Systems	B.E. / B.Tech -Electronics and Communication Engineering, Electronics Engineering.

FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF CIVIL ENGINEERING
M.E., ENVIRONMENTAL ENGINEERING

VISION

To become

SCHOOL OF EXCELLENCE IN CIVIL ENGINEERING

With **Conformity, Quality and Standards**

in **teaching, research, training** and **consultancy**

towards producing globally competent Civil Engineers**.**

MISSION

M1: To Promote quality in education, research and professional training for satisfying the needs of industry and society.

M2: To provide state-of-the-art facilities and resources that contributes to a congenial learning environment.

M3: To establish Centers of Excellence in emerging areas of Civil Engineering for the students to acquire domain specific expertise and also facilitate Industry- Institution interaction.

M4: To inspire the students to pursue higher education and take competitive examinations and various career enhancing programs.

M5: To instill the professional ethics and their role for sustainable development and corruption-free country.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1	To promote student's aptitude in all Environmental Engineering subjects such as water & waste water, meteorology& air pollution, Solid Waste, Noise , Climate Change, etc.
PEO 2	To build professional knowledge in Environmental Engineering through class room teaching, laboratory practice for analysis of attributes and field demonstration for sampling of attributes and monitoring.
PEO 3	To develop soft skill through numerical modelling tools and expert systems for data acquisition, prediction analysis and design of systems.
PEO 4	To impart subject specific knowledge with objective information on the challenges ahead like Climate Change with methodologies towards solutions.

PEO 5	To sensitize the need and importance to pursue for higher studies, research and training to remain competent to face any future challenges of environmental protection.

POs for PG Programme

	POs for PG Programme
P01	**Scholarship of Knowledge** Acquire in-depth knowledge of specific discipline or professional area, including wider and glob perspective, with an ability to discriminate, evaluate, analyse and synthesis existing and new knowledge and integration of the same for enhancement of knowledge
P02	**Critical Thinking** Analyse complex engineering problems critically, apply independent judgement for synthesising information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.
P03	**Problem Solving** Think laterally and originally, conceptualise and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise
P04	**Research Skill** Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyse and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually in group(s) to the development of scientific/technological knowledge in one or more domains of engineering
P05	**Usage of modern tools** Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations.
P06	**Collaborative and Multidisciplinary Work** Possess knowledge and understanding of group dynamics. recognise opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self- management and teamwork. decision-making based on open-mindedness. objectivity and rational analysis in

	order to achieve common goals and further the learning of themselves as well as others
P07	**Project Management and Finance** Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.
P08	**Communication** Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.
P09	**Life-long Learning** Recognise the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously
P010	**Ethical Practices and Social Responsibility** Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.
P011	**Independent and Reflective Learning** Observe and examine critically the outcomes of one's actions and make correctiv measures subsequently, and learn from mistakes without depending on externa feedback.

PSOs for **PG Programme**

Programme specific Outcomes (PSOs) on completion of M.E. (Environmental Engineering) programme, graduate will be able to

PSO1	Acquire in depth knowledge to plan analyze, design and evaluate the environmental engineering systems.
PSO2	Independently carryout research investigation to solve field problems and preparation of technical report.
PSO3	Understand and evaluate the environmental impacts and climate change with the respective need, methodologies and urgency for promoting climate resilient development.

	M1	**M2**	**M3**	**M4**	**M5**
PEO_1	**2**			**3**	
PEO_2	**3**	**1**			**2**
PEO_3	**1**			**2**	
PEO_4	**3**		**3**	**1**	**1**
PEO_5				**3**	**1**

	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}
PEO_1	3	1	2				1		3		
PEO_2	3	2	2		3						
PEO_3	1	1									
PEO_4	3	2	3		1		3				
PEO_5				3					1	1	

DETAILS OF COURSE CODE

S. No	3rd & 4th Digits	DETAILS		5th & 6th Digits	DETAILS	7th & 8th Digits	DETAILS
1	CE	Civil Engineering	i	WR	Water Resources Engineering & Management	PC	Program Core
			ii	EE	Environmental Engineering		
2	CZ	Civil & Structural Engineering	i	SE	Structural Engineering	PE	Program Elective
			ii	CM	Construction Engineering. and Management		
3	ME	Mechanical Engineering	i	TP	Thermal Power Engineering	OE	Open Elective
			ii	EM	Energy Engineering & Management		
4	MF	Manufacturing Engineering	i	ME	Manufacturing Engineering	CP	Core Practical
5	EE	Electrical Engineering	i	PS	Power System Engineering	TS	Industrial Training and Seminar
6	EI	Electronics & Instrumentation Engineering	i	PC	Process Control & Instrumentation	PV	Project work & Viva-voce
7	CH	Chemical Engineering	i	CE	Chemical Engineering	MC	Mandatory Learning Course
			ii	FT	Food Processing Technology		

8	CS	Computer Science and Engineering	i	CS	Computer Science and Engineering	AC	Audit Course
9	EC	Electronics & Communication Engineering	i	CS	Communication Systems		
10	YY	Name of the Department					
11	ZZ	Name of the Program					

The first two digits relate to the year from which the Regulations commence

9th digit represents the semester and 10th digit represents the serial number of courses.

YY and ZZ relates to the Open Elective where YY corresponds to Name of the Department and ZZ to Name of the Program.

SEMESTER I									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
23CEEEPC11	**PC**	Physico-Chemical Treatment Systems for Water & Wastewater	3	-	-	25	75	100	3
23CEEEPC12	**PC**	Air Pollution Monitoring and Control	3	-	-	25	75	100	3
23CEEEPE13	**PE**	Program Elective-I	3	-	-	25	75	100	3
23CEEEPE14	**PE**	Program Elective-II	3	-	-	25	75	100	3
23CEEEMC15	**MC**	Research Methodology and IPR	2	-	-	25	75	100	2
23CEEECP16	**CP**	Environmental Process Monitoring Laboratory	-	-	4	40	60	100	2
23CEEECP17	**CP**	Unit Operations & Process Laboratory	-	-	4	40	60	100	2
23CEEEAC18	**AC**	Audit Course-I	2	-	-	-	-	-	0
Total									**18**
SEMESTER II									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
23CEEEPC21	**PC**	Biological Treatment Systems for Water & Wastewater	3	-	-	25	75	100	3
23CEEEPC22	**PC**	Solid Waste Management	3	-	-	25	75	100	3
23CEEEPE23	**PE**	Program Elective-III	3	-	-	25	75	100	3
23CEEEPE24	**PE**	Program Elective-IV	3	-	-	25	75	100	3
23CEEEOE25	**OE**	Open Elective (Inter Faculty)	3	-	-	25	75	100	3
23CEEECP26	**CP**	Environmental Research Laboratory	-	-	4	40	60	100	2
23CEEETS27	**TS**	Industrial Training and Seminar/Mini Project		Tr 2	S 2	40	60	100	2
23CEEEAC28	**AC**	Audit Course-II	2	-	-	-	-	-	0
							Total		**19**

SEMESTER III									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
23CEEEPE31	**PE**	Program Elective-V	3	-	-	25	75	100	3
23CEEEOE32	**OE**	Open Elective (Inter Faculty)	3	-	-	25	75	100	3
23CEEEPV33	**PV-I**	Project work & Viva-voce Phase-I Dissertation-I	-	Pr 16	S 4	40	60	100	10
Total									**16**
SEMESTER IV									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
23CEEEPV41	**PV-II**	Project work & Viva-voce Phase-II Dissertation-II	-	Pr 24	S 6	40	60	100	15
Total									**15**

GRAND TOTAL CREDITS: 68

PC	**Program Core**	**CP**	Core Practical	**AC**	Audit Course
PE	**Program Elective**	**TS**	Industrial Training and Seminar	**PV**	Project work & Viva-voce
OE	**Open Elective**	**MC**	Mandatory Learning Course	**CE**	Branch code
				EE	M.E Specialization Code

PROGRAMME ELECTIVES (PE)

Sl. No.	**Course Code**	**Course Title**
1	23CEEEPEXX	Environmental Impact Assessment
2	23CEEEPEXX	Membrane Technology
3	23CEEEPEXX	Emission Control and Treatment Systems
4	23CEEEPEXX	Climate Change and Adaptation
5	23CEEEPEXX	Air Pollution Meteorology and Modelling

6	23CEEEPEXX	Remote Sensing & GIS
7	23CEEEPEXX	Operation and Maintenance of ETP
8	23CEEEPEXX	Landfill Engineering & Remediation
9	23CEEEPEXX	Noise Pollution & Control

OPEN ELECTIVES (OE)

Sl. No.	Course Code	Course Title
1	23CEEEOEXX	Statistics for Environmental Research
2	23CEEEOEXX	Marine Pollution & Control
3	23CEEEOEXX	Environmental Biotechnology
4	23CEEEOEXX	Sustainable Development & Circular Economy
5	23CEEEOEXX	Environmental Legislation
6	23CEEEOEXX	Composite Materials
7	23CEEEOEXX	Business Analytics
8	23CEEEOEXX	Industrial Safety
9	23CEEEOEXX	Operations Research
10	23CEEEOEXX	Cost Management of Engineering Projects
11	23CEEEOEXX	Waste To Energy
12	23CEEEOEXX	Online MOOC course or other courses

AUDIT COURSES (AC)

SL.NO	Course Code	COURSE TITLE
1	23CEEEACXX	English For Research Paper Writing
2	23CEEEACXX	Disaster Management
3	23CEEEACXX	Sanskrit For Technical Knowledge
4	23CEEEACXX	Value Education
5	23CEEEACXX	Constitution Of India
6	23CEEEACXX	Pedagogy Studies
7	23CEEEACXX	Stress Management By Yoga
8	23CEEEACXX	Personality Development Through Life Enlightenment Skills

23CEEEPC11	PHYSICO-CHEMICAL TREATMENT FOR WATER & WASTEWATER	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Students shall become well conversant with the basis and principles of processes and unit operations for various Physico- chemical treatment plants for water and wastewater.
- Students shall gain competency in the design of physical, chemical and the combination of treatment systems and also on the system components comprising, to enable them to make the right choice of process and the design treatment plants.
- Students shall understand the managerial issues in the operation, maintenance, data-logging and Compliance Standards in the planning, designing and managing Physico Chemical units operations of water and wastewater treatment plants

Pollutants in water and wastewater–Physical, Chemical, Biological and Radiological characteristics- Interpretations- Significance of Physico-chemical treatment– Limitations- Choice of Chemicals- Optimization of Chemical use- Side stream waste generation.

Physico Chemical Treatment Processes; Physical treatment- Screening: Bar, Coarse and Fine Screens- Disposal of screenings– Grit Chamber: Parshall Plume& Venturi Plume- Critical Velocity- Flotation; Skimming, Air Flotation and Diffused Air Floatation-Equalization –Sedimentation; Settling Tank, Clarifiers, Clariflocculators and Tube Settlers – Filtration – Sand and Multimedia Filters – Gravity & Pressure Filters- Up flow & Down flow Filters.

Principles of Chemical Treatment Processes; Chemical Mixing & Preparation; Mixers: Types and Speed of Impellers- Energy dissipation- Coagulation: Coagulants - Limitations Flocculation: Ortho kinetic and Peri kinetic-–Oxidation-Precipitation– Disinfection: Chlorination, UV Radiation and Ozonation - Ion exchange; Resins, Types of Resins-Limitations - Electrolytic methods: Membranes –Limitations- Advanced Oxidation/Reduction- Sludge dewatering: Centrifuge and Filter Press- Sludge Management.

Advanced Processes: Membrane separation; Micron Filtration, Ultra filtration, Nano Filtration and Reverse Osmosis- Membrane Flux- Limitations- Cleaning & Flushing- Operational Conditions – PLC Controls- Management of Membrane Plants.

O&M Schedules: Monitoring Parameters- Instrumentation- Online monitoring & SCADA systems- Monitoring Schedules - Data Compiling & Reporting- Monitoring Schedules- Reporting- Residue management–Up gradation of existing plants- Compliance to Standards of treatment.

REFERENCES

1. Metcalf and Eddy, "Wastewater Engineering, Treatment and Reuse" ,Tata McGraw Hill, New Delhi, 2003.
2. Qasim.S.R., Motley, E.M and Zhu.G. "Water works Engineering – Planning, Design and Operation", Prentice Hall, New Delhi, 2002.
3. Lee, C.C. and Shun dar Lin, "Handbook of Environmental Engineering Calculations", McGraw Hill, New York, 1999.
4. Spellman F.R., "Hand Book of Water and Wastewater Treatment Plant operations", CRC Press, New York 2009.

COURSE OUTCOMES

1. Students shall understand the importance of characterization and parameters of treatment. Students will come to know the basis and principles of Physico- Chemical processes and alternative chemicals used for water and wastewater treatment.
2. Students shall know on all options of Physical treatment processes for water and wastewater into treatment processes and their application requirements and respective efficiencies.
3. Students shall know on all options of Chemical treatment processes for water and wastewater into treatment processes and their application requirements and respective efficiencies.
4. Students will get to know all types of membrane based treatment processes and their respective suitability for the treatment of water and wastewater
5. Students have also got to know the monitoring schedules and Compliance Standards for the management of Physico Chemical unit operations of Water and Wastewater Treatment Plants.

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2									3	2	1
CO2		1	2		3							3	2	1
CO3		1	2		3							3	2	1
CO4		1	2		3							3	2	1
CO5		1	2		3							3	2	1

23CEEEPC12	AIR POLLUTION MONITORING AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Students shall understand the Ambient Air Quality Standards with the sources of anthropogenic sources of air pollution.
- Students shall understand the Protocols and Procedures for ambient air sampling and analysis.
- Students shall understand the point and area sources of air pollution and the respective control methods.
- Students shall study on the choices of air cleaning equipment for particulate/ gaseous air pollutants.
- Students have also got to know the Compliance Standards for Planning, Designing and management of Emission Cleaning equipment.

Classification and Properties of Air Pollutants

Emission sources -major emissions from Global sources -importance of anthropogenic sources- behavior and fate of air pollutants- photochemical smog effects of air pollution health, vegetation and materials damage in India air pollution standards -different types of terrain – effects of terrain features on atmosphere – mechanical and thermal turbulence- Indoor air pollution.

Meteorological Aspects of Air Pollution Dispersions

General Atmospheric Circulation, Atmospheric Thermodynamics, Atmospheric Stability, Boundary Layer Development-Effect of Meteorology on Plume Dispersion, Wind Velocity, Wind Rose, Local Climatological Data-Air Quality Modeling: Types of Plumes, Flow Regimes of a Plume, Plume Rise, Ambient Air Concentration Modeling-Gaussian Dispersion Models, Plume Dispersion Parameters, Computer Programs, USEPA Recommended Models

Air Pollution Sampling and Measurement

Air pollution sampling and measurement- types of pollutant sampling and measurement- Ambient air sampling- Analysis of Gaseous air pollutants- Particulate pollutants- Aerosols – Black Carbon -stack sampling, analysis of air pollutants- sulphur dioxide- nitrogen dioxide, carbon monoxide, oxidants and ozone- hydrocarbons, particulate matter.

Control Methods:

Sources- correction methods- -particulate emission control- gravitational settling chambers- cyclone separators- fabric filters- electrostatic precipitators- wet scrubbers- -control of gaseous emissions- adsorption by solids- absorption by liquids- combustion, condensation – control of SO_2 emission – desulphurization of flue gases – dry methods – wet scrubbing methods. Control of sulphur dioxide emission- desulphurization of flue gases- dry methods- wet scrubbing methods- control of nitrogen oxides- modification of operating conditions- modification of design conditions- effluent gas treatment methods- carbon monoxide control- control of hydrocarbons.

Vehicular Air Pollution:

Genesis of Vehicular emissions- Natural Pollution- Gasification of Vehicles- Point sources of Air Pollution from automobiles- Fuel tank, carburetor and crank case- Exhaust emissions- Mechanism of Origin of air pollution from automobiles. Automobile air pollution – Indian Scenario- Population and pollution loads of vehicles- Automobile Pollution Control- Control at sources- Exhaust gas treatment devices- Alternate fuels comparison- Thermal Reactor- Catalytic Converter- Automobile Emission Control- Legal measures.

Textbooks

1. Air Pollution, H.C.V.Rao, 1990, McGraw Hill Co.
2. Environmental Pollution Control, C.S.Rao, Wiley Eastern Ltd.,1993
3. Air Pollution , M.N.Rao McGraw Hill 1993.

REFERENCES

1. Fundamentals of Air Pollution, Samuel, J.W., 1971, Addison Wesley Publishing Co.
2. Air Pollution, Kudesia, V.P. International Student Edition McGram-Hill-Kosakusha Ltd.,Tokyo.
3. Air Pollution Control and Engineering, De Nevers, Mc Graw- Hills, 1993

COURSE OUTCOMES

1. Students will understand sources and types of sources of air pollution and will come to classify and characterize the air pollutants.

2. Students will become conversant with AAQ Monitoring methodology. Students will become conversant with equipment including offsite sampling and laboratory analysis.
3. Students will understand the concept and design methodologies for the removal of particulates through all types of Cyclones and Scrubbers.
4. Students will understand the concept and design methodologies for the removal of gaseous pollutants through all types of Scrubbers
5. Students will understand the concept and design methodologies for the control of automobile pollution.

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2									3	2	1
CO2		1	2		3							3	2	1
CO3		1	2		3							3	2	1
CO4		1	2		3							3	2	1
CO5		1	2		3							3	2	1

23CEEEMC15	**RESEARCH METHODOLOGY AND IPR**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

COURSE OBJECTIVES

- Students shall understood control of today's world by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Students shall understood IPR protection in research work and investment in R & D

Research problem

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.

Investigation

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Technical writing

Effective literature studies approaches, analysis Plagiarism, Research ethics.

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

IPR

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Patterns

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

REFERENCES

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012)
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets,” Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques,” Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice,” September 2013.

COURSE OUTCOMES

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyse research related information and follow research ethics
3. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
4. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasise the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Mapping of COs with POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1		3	2								3	2	1
CO2			2	3	1							3	2	1
CO3	1			2				3				3	2	1
CO4									1	3	2	3	2	1
CO5									1	3	2	3	2	1

23CEEECP16	ENVIRONMENTAL PROCESS MONITORING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

To conduct laboratory studies on

1. Water and wastewater samples.
2. Monitoring Air Pollution and Noise Level.
3. Microscopic examination for water and waste water.

LIST OF EXPERIMENTS

1) pH Meter - Determination of pH of Samples
2) Conductivity Meter - Determination of Specific conductance of Samples
3) Turbidity Meter - Determination of turbidity (NTU) of Samples
4) Jar test apparatus - Determination of the optimum dosage of coagulant
5) Determination of Chemical Oxygen Demand (COD) of samples
6) Determination of Biochemical Oxygen Demand (BOD_5) of samples
7) Determination of Solids in the samples
   a) Suspended solids
      Settle able solids
      Non-Settle able solids
   b) Dissolved solids

Volatile solids
Fixed solids

8) Determination of Hardness of samples (EDTA method)
9) Determination of chloride of samples (Mohr's method)
10) Determination of Dissolved Oxygen of samples (Winkler's method)

Air Pollution & Noise Level Monitoring

11) Estimation of: NO_x, SO_x, SPM, HC, CO
12) Noise level
13) **Environmental Microbiology**

General techniques of microbiology: Media preparation, sterilization, inoculation, cultivation, isolation, purification and enumeration. (plate count, membrane filtration method). Kinetics of bacterial growth: Bacterial growth curve, estimation of number of generations, generation time. Determination of microbial quality of water: standard plate count, standard coliform test, determination of coliform density by MPN method fecal coliform test, fecal streptococcal plate count, Morphological identification of various common soil fungi, Microscopic examination of different algae of water and wastewater

COURSE OUTCOMES

At the end of this course, students will be able to;

1. Will become conversant on all primary parameters of Environmental attributes.
2. Will aware of Standard Protocols and Procedures in conducting the experiments.
3. Will understand the required interpretation of results for the evaluation.
4. Will become conversant on the Standards on Quality and Permissible levels of parameters for all respective attributes of environment.
5. Will become conversant in use of instruments and the respective SOPs.

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	3					2		3	2	2
CO2	3	3	2	2	3					2		3	2	2
CO3	3	3	2	2	3					2		2	2	2
CO4	3	3	2	2	3					2		2	2	3
CO5	3	3	2	2	3					2		3	2	3

23CEEECP17	UNIT OPERATIONS & PROCESS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

To conduct laboratory studies on water and wastewater treatment units.

LIST OF EXERCISE

1) Determination of DO, MLSS and SVI in Activated Sludge Process.
2) Determination of F/M in an Activated Sludge Process.
3) Determination of free available chlorine – Disinfection efficiency.
4) Determination of Kinetic coefficients of a Activated Sludge Process.
5) Determination of Kinetics of a Anaerobic reactor.
6) Evaluation of the efficiency of coagulant and flocculant in settling.
7) Determination of kinetics in MBR process.
8) Determination of filtration kinetics in various adsorption columns.

REFERENCES

1. Metcalf & Eddy, Inc. 'Wastewater Engineering, Treatment, Disposal and Reuse, Third Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi 2003.
2. Lee, CC & Shun dar Lin, Hand book of Environmental Engineering Calculations, Mc Graw Hill, New York, 1999.
3. Casey T.J. Unit treatment processes in water and wastewater engineering, John Wiley's Sons, London, 1993.

COURSE OUTCOMES

At the end of this course, students will be able to;

1. Will become conversant on all primary parameters of Environmental attributes.
2. Will become conversant in use of instruments and the respective SOPs
3. Will aware of Standard Protocols and Procedures in conducting the experiments.
4. Will understand the required interpretation of results for the evaluation.
5. Will become conversant on the Standards on Quality and Permissible levels of parameters for all respective attributes of environment.

Mapping of COs with POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	3					2		3	2	2
CO2	3	3	3	3	3					2		3	2	2
CO3	3	3	3	3	3					2		2	2	2
CO4	3	3	3	3	3					2		2	2	3
CO5	3	3	3	3	3					2		3	2	3

23CEEEPC21	BIOLOGICAL TREATMENT SYSTEMS FOR WATER & WASTEWATER	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Students shall understood the basis and principles of various Biological treatment processes and unit operations for water and wastewater
- Students shall become conversant in the design of treatment processes and unit operations.
- Students shall become competent to make ch
- oice on specific process or combination thereof.
- Students shall aware of the monitoring parameters, instrumentation and data compilation and reporting on operating the treatment plants.

Biological treatment Processes; Principles of aerobic and anaerobic processes - Kinetics of biological growth – Factors affecting growth – Attached and Suspended growth - Determination of Kinetic coefficients– Biodegradability assessment -Selection of process- Reactors- : batch & continuous .

Aerobic Treatment; Principle of Aerobic Oxidation- Process control Parameters- Microorganisms- Activated Sludge process- Sequencing Batch reactors- Membrane Biological Reactors-Trickling Filters-BioTower-RBC-Moving Bed Reactors- Fluidized bed reactors-Aerated lagoons- Waste stabilization ponds. Nutrient Removal Systems – Natural treatment systems- Constructed wet land– Reclamation and reuse – Flow charts, layout, PID, hydraulic profile- Case Studies.

Anaerobic treatment; Principle of Anaerobic Digestion- Process control Parameters- Microorganisms- Conventional & High Rate Digesters – Two Phase Digesters - UASBR-

Up flow filters - Fluidized bed Reactor- Gas Collection, Storage & Transfer- Flow chart, Layout and Hydraulic profile – Case Studies

Sludge Treatment and Disposal ;Design of sludge management facilities- Sludge thickening- Sludge digestion- Sludge dewatering (Centrifuge and Filter Press) Layout, PID, Hydraulics profile – Upgrading existing plants – Ultimate residue disposal – Recent advances.

Operations and Maintenance Schedules ; Planning, Organizing and controlling of plant operations-Monitoring parameters - Continuous Operation& Maintenance – Instrumentation–Data compiling & Reporting– Retrofitting- Case studies.

REFERENCES

1. ArceivalaS.J., and Asolekar S.R "Wastewater Treatment for Pollution Control and reuse "McGraw Hill, third Edition, New Delhi, 2007.
2. Manual on “Sewerage and Sewage Treatment” CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
3. Metcalf & Eddy, INC, Wastewater Engineering – Treatment and Reuse, Fourth Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003.
4. Qasim, S. R. "Wastewater Treatment Plant, Planning, Design & Operation", Technomic Publications, New York, 1994.
5. F.R. Spellman, "Hand Book of Water and Wastewater Treatment Plant operations", CRC Press, New York 2009.
6. David Hendricks, “Fundamentals of Water Treatment Process", CRC Press, New York 2011.

COURSE OUTCOMES

1. Students will understand the principles of biological treatment of water and wastewater with different approaches and types of biological treatment.
2. Students will appreciate and gain the ability to choose the type of aerobic biological treatment processes and design the treatment plant.
3. Students will appreciate and gain the ability to choose the type of anaerobic biological treatment processes and design the treatment plant.
4. Students will be able to choose the type of biological treatment processes for sludge disposal and management.
5. Students will become conversant with O&M and Trouble shooting in the operation of Water and Wastewater treatment plants.

Mapping of COs with POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3											3		
CO2		3	3									3	2	
CO3		3	3									3	3	
CO4												3	1	
CO5		3										3	1	

23CEEEPC22	SOLID WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Students shall be taught on different methods of sampling, analysis and characterization of solid waste streams.
- Students shall be imparted with knowledge and skills in the collection, storage, transport, treatment, disposal and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipment.
- Students shall be made aware on different classification and types of Solid Waste streams on the basis of the characteristics and proven methods of treatment.
- Students shall be specifically taught on Plastic and eWaste management.
- Students shall be made to understand all set of Rules, Notifications and Amendments to respective Solid waste Management by MoEF&CC

Classification and Regulatory framework

Types and Sources of solid waste Streams - Need for solid and hazardous waste management – Salient features of Indian legislations on Management and Handling of Solid Wastes; MSW, Hazardous Wastes, Bio Medical Wastes, Nuclear wastes ,Batteries waste, eWaste, Waste plastics , Fly ash and Demolition Waste.

Waste characterization and source reduction

Waste generation rates and variation – Composition- Proximate and Ultimate Analysis- Characteristics: physical, chemical and biological – Hazardous Characteristics – TCLP tests – Waste sampling and characterization plan - Source reduction of wastes – Extended Producer Responsibility - Recycling and reuse

Storage, Collection and Transport of wastes

Handling and segregation of wastes at source – Storage and Collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer

stations- Optimizing waste Collection –Labelling and Handling of hazardous wastes – Hazardous waste Manifests and Transport

Waste processing technologies

Objectives of waste processing – Material separation and processing technologies – Concept of Alternative Fuel & Raw Materials (AFR)-Biological and Chemical technologies – Composting: Methods and controls – In vessel Composting - Thermal technologies: Pyrolysis and Incineration- Types of Incinerators – Solidification and Stabilization of hazardous wastes - Treatment of Biomedical wastes - Health considerations in the context of operation of facilities- Concept of Common facilities.

Waste Disposal

Landfills - Classification, Types and Methods – Site selection - Design and Operation of Sanitary landfills, secure landfills and Landfill bioreactors – Leachate and landfill gas management – landfill closure and Environmental Monitoring – Rehabilitation of open dumps-Remediation of contaminated sites. Elements of integrated waste management; stakeholders - Financing and Public Private Participation for waste management- Sustaining the informal sector of waste pickers- Integrated Solid waste Management Facilities.

REFERENCES

1. George Technoboglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.
2. CPHEEO, “Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization Government of India, New Delhi, 2014.
3. William A. Worrell, P. AarneVesilind, Solid Waste Engineering, Cengage Learning, 2012.
4. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York,2010.
5. John Pitchtel, Waste Management Practices, CRC Press, Taylor and Francis Group,2014.
6. Frank Kreith, George Tchobanoglous ,Handbook of Solid Waste management, McGraw Hill, 2002.

COURSE OUTCOMES

Students are expected to understand the following;

1. Students will become conversant on characteristics of different types of solid and hazardous wastes and the factors affecting variation and managerial issues. They will

understand the Planning and Design concepts of integrated solid waste management and technical solutions for its strategic management with resource recovery.

2. Students will become conversant on Waste characterization and sampling
3. Students will become conversant on Collection, Storage and Extended Producer responsibility.
4. Students will become conversant on Waste processing ,Treatment including Incineration
5. Students will become conversant on Landfill for ultimate disposal and comprehensive management

Mapping of COs with POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		3											3	
CO2			3									3		
CO3										2				3
CO4			3									3		
CO5							3						3	

23CEEECP26	ENVIRONMENTAL RESEARCH LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To conduct laboratory studies on water and wastewater treatment units.

LIST OF EXPERIMENTS

1) Coagulation and Flocculation.
2) Batch studies for sedimentation.
3) Characteristics of Filter media.
4) Studies on Filtration.
5) Water softening.
6) Adsorption studies / Kinetics.
7) Silt Density Index.
8) Reverse Osmosis.
9) Kinetics of suspended growth process (activated sludge process).
10) Kinetics of attached growth process (Rotating Biological Contactors).
11) Sludge volume Index.
12) Anaerobic Reactor systems / Kinetics.

13) Advanced Oxidation Processes.
14) Chlorine Demand Estimation.

REFERENCES

1. Metcalf & Eddy, Inc. 'Wastewater Engineering, Treatment, Disposal and Reuse, Third Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi 2003.
2. Lee, CC & Shun dar Lin, Hand book of Environmental Engineering Calculations, Mc Graw Hill, New York, 1999.
3. Casey T.J. Unit treatment processes in water and wastewater engineering, John Wileys Sons, London, 1993.

COURSE OUTCOMES

1. Will become conversant on all primary parameters of Environmental attributes.
2. Will become conversant in use of instruments and the respective SOPs
3. Will aware of Standard Protocols and Procedures in conducting the experiments.
4. Will understand the required interpretation of results for the evaluation.
5. Will become conversant on the Standards on Quality and Permissible levels of parameters for all respective attributes of environment.

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3		1	2								1	2	3
CO2	3		1	2								1	2	3
CO3	3		1	2								2	3	1
CO4	3		1	2								3	2	1
CO5	3		1	2								1	2	2

23CEEETS27	**INDUSTRIAL TRAINING AND SEMINAR/ MINI PROJECT**	**L**	**T**	**P**	**C**
		-	**Tr**	**S**	**2**
			2	**2**	

SEMINAR

COURSE OBJECTIVES

- To take on hand training on specific work environment with specific nature of works.
- To work on a technical topic related to Environmental Engineering and acquire the ability of written and oral presentation
- To acquire the ability of writing technical papers for Conferences and Journals

The students will work for two periods per week guided by student counselor and a seminar will be conducted for not less than fifteen minutes and not more than thirty minutes on any technical topic of student's choice related to relevant subject. The students will defend their presentation and interact with audience. A brief copy of their presentation also should be submitted. Evaluation will be done by the student counselor based on the technical presentation and the report and also on the interaction shown during the seminar.

COURSE OUTCOMES

1. Discover potential research areas in the field of Environmental Engineering
2. Compare and contrast the several existing solution for research challenge
3. Demonstrate an ability to work in teams and manage the conduct of the research study
4. Formulate and purpose a plan for creating a solution for the research plan identified
5. To report and present the findings of the study conducted in the preferred domain

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		2	1	3								3	2	1
CO2		2	1	3								3	2	1
CO3		2	1	3								3	2	1
CO4		2	1	3								3	2	1
CO5		2	1	3								3	2	1

INDUSTRIAL TRAINING

COURSE OBJECTIVES

- To train the students in the field of Environmental Engineering and enrich practical knowledge to carry out the relevant works in the field.
- To train and develop skills in solving problems during execution of certain works related to the field of specialization.

The students individually undergo a training program in reputed concerns in the field of Environmental Engineering during the summer vacation (at the end of second semester for full – time / fourth semester for part – time) for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training obtained, within ten days from the commencement of the third semester for Full-time / fifth semester for part-time. The students will be evaluated by a team of staff members nominated by head of the department through a viva-voce examination.

COURSE OUTCOMES

1. The students can face the challenges in the practice with confidence.
2. The student will be benefited by the training with managing the situation arises during the execution of works.

23CEEEPV33	**PROJECT WORK & VIVA-VOCE PHASE-I / DISSERTATION-I**	L	T	P	C
		-	Pr	S	10
			16	4	

COURSE OBJECTIVES

- To train the students in the field of Environmental Engineering and enrich practical knowledge to carry out the relevant works in the field.
- To train and develop skills in solving problems during execution of certain works related to the field of specialization.

The students individually undergo a training program in reputed concerns in the field of Environmental Engineering during the summer vacation (at the end of second semester for full – time / fourth semester for part – time) for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training obtained, within ten days from the commencement of the third semester for Full-time / fifth semester for part-time. The students will be evaluated by a team of staff members nominated by head of the department through a viva-voce examination.

COURSE OUTCOMES

1. Ability to effectively gather and interpret information from literature survey. And use this knowledge to identify, formulate, analyse and solve complex problems and to evaluate and interpret various solutions
2. Gain the ability to communicate effectively with written, oral, and visual means in a technical setting.
3. Ability to use modern design and analysis tools.
4. Students will be able to carry out calculations involved in design, consider and evaluate altemate assumptions, approaches, and procedures. Ability to fabricate system components related to engineering problems giving consideration to environment and society
5. Ability to serve as effective team member to plan and complete the project/task within a specified budget and time.

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		2	1	3								3	2	1
CO2		2	1	3								3	2	1
CO3			1	2	3							3	2	1
CO4		2	1	3								3	2	1
CO5		2	1	3								3	2	1

23CEEEPV41	**PROJECT WORK & VIVA-VOCE PHASE-II / DISSERTATION-II**	**L**	**T**	**P**	**C**
		-	**Pr**	**S**	**15**
			24	**6**	

COURSE OBJECTIVES

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

COURSE OUTCOMES

1. Ability to effectively gather and interpret information from literature survey. And use this knowledge to identify, formulate, analyse and solve complex problems and to evaluate and interpret various solutions
2. Gain the ability to communicate effectively with written, oral, and visual means in a technical setting.
3. Ability to use modern design and analysis tools.
4. Students will be able to carry out calculations involved in design, consider and evaluate altemate assumptions, approaches, and procedures. Ability to fabricate system components related to engineering problems giving consideration to environment and society
5. Ability to serve as effective team member to plan and complete the project/task within a specified budget and time.

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		2	1	3								3	2	1
CO2		2	1	3								3	2	1
CO3			1	2	3							3	2	1
CO4		2	1	3								3	2	1
CO5		2	1	3								3	2	1

PROFESSIONAL ELECTIVES

23CEPEPEXX	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan.
- To provide knowledge related to the broad field of environmental risk assessment, and prepare Disaster Management Plan.
- To understand the role of Environmental Impact Assessment as an important policy tool for sustainable development.

Historical development of Environmental Impact Assessment - EIA in Project Cycle-Legal and Regulatory aspects in India – EIA Notification,2006 and its subsequent amendments. Types and limitations of EIA –EIA process- screening – scoping - setting – analysis – mitigation- Cross sectoral issues and terms of reference in EIA – Public Participation in EIA-EIA Consultant Accreditation.

EIA Landscape: Matrices – Networks – Checklists –Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical Modelling for impact prediction – Assessment of impacts – air – water – soil – noise – biological — Socio Economics- Cumulative Impact Assessment.

Social impact assessment - Relationship between social impacts and change in community and institutional arrangements- Individual and family level impacts. Communities in transition Documentation – Planning – Organization of information-Public Consultation - Role of NGO.

Environmental Management Plan; Preparation- Implementation and review of EMP– Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies

Environmental risk assessment framework- Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk

Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multi pathway exposure Modelling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs.

REFERENCES

1. Canter, L.W., Environmental Impact Assessment, Mc Graw Hill, New York. 1996
2. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003
3. World Bank –Source book on EIA
4. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
5. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.
6. Raghavan K. V. and Khan A., Methodologies in Hazard Identification and Risk Assessment, Manual by CLRI, 1990.
7. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control, 4th Edition, Butterworth Heineman, 2012.

COURSE OUTCOMES

1. After the completion of course, the student will be able to appreciate the importance of Environmental Impact Assessment and its role in developmental activities, including Indian Legislation pertaining to EIA.
2. The student will also know the basics and stages of EIA landscape, limitations and framework in different formats.
3. The student will appreciate the SIA and role of NGOs.
4. The student will also know the basics and stages of EMP landscape, limitations and framework in different formats.
5. The student will become conversant on Risk Analysis and Disaster Management Plans.

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2			2			1		2	1	1		
CO2	3	2	2	1	1	2						2	3	
CO3	2					1	3	2	1				1	2
CO4	2	2	2	2					1		2		1	
CO5	2		2											3

23CEEEPEXX	MEMBRANE TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Necessity and advantages of Membrane technology in place of conventional systems for water and wastewater treatment
- Membrane Types, Proprietary data and Expert systems for planning and designing of Membrane based treatment plants
- Operation and maintenance of membrane based plants.

Solids removal suspended solids and dissolved solids – organic, inorganic and inert solids – membrane processes – principle and theory – materials of membranes – proprietary products – selectivity modules – concentration polarization – membrane fouling and cleaning – applications.

Mechanism of membrane transport – RO/UF transport – solution diffusion model – dual sorption model – free volume theory – pore flow model – resistance model - boundary layer film model – Membrane modules; flat cartridge, spiral wound, tubular hollow fibre – Design equations – Expert systems of proprietary products.

Membrane preparation techniques – isotropic membranes anisotropic membranes metal membranes, ceramic membranes liquid membranes and biomembranes; MF UF, NF and RO – specific applications and limitations – Applications.

Engineering aspects of membranes; Hybrid membrane techniques; membrane reactor, membrane distillation membrane extraction and osmotic distillation – Design equations – Applications.

O& M of MF/UF/NF and RO Plants- Membrane Chemical Cleaning – Chemicals including SMBS- Instrumentations -SCADA systems for operation –Data Maintenance.

REFERENCES

1. Christie J. Geankoplis,, Transport Process and Unit Operations, 3rd Edn., Prentice Hall of India Pvt. Ltd.
2. Sun, Tak, Hwang and Karl Kammermayer, Membranes in separations, John Wiley and Sons, New York.

3. Richard W.Naker, Membrane Technology and Applications. John Wiley and Sons, 2004
4. Separation Process Principles by J.D. Seader and Ernest J.Henley, John John Wiley and Sons, 200.
5. Coulson J.M and Richardson, Chemical Engineering – Particle Technology and Separation Process Vol.2 th edition. Asian Books Pvt. Ltd. New Delhi 1998.
6. Warren L.McCabe, Julian Smith and Peter Harriot, Unit Operations of Chemical Engineering, th edition. 2004.
7. Judson King .C Separation Process, McGraw Hill Inc,, 1980.
8. Hoffman E.J, Membrane separations Technology Single stage, multi stage and Differential permeation, Gulf Professional Publishing.

COURSE OUTCOMES

1. Students should have understood the principles of different membrane treatment processes and different types of membranes.
2. Students should have known different types of membranes and their respective limitations and application suitability.
3. Students should have become knowledgeable to design a suitable membrane separation process.
4. Students should have understood the Composite membrane process for a specific application and design packages for proprietary membrane systems.
5. Students should have understood the O&M protocols including Cleaning chemicals, instrumentation and data maintenances.

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3			2	1							3	2	1
CO2	3			2	1							2	3	1
CO3	3			2	1							1	2	3
CO4	3			2	1							2	3	1
CO5	3			2	1							1		3

23CEEEPEXX	EMISSION CONTROL AND TREATMENT SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Students shall enable to characterize the Emission Stacks as Point Sources from industrial processes with respect to nature of industries
- Students shall know to design the systems to control and remove particulates and gaseous pollutants from the emission of the stack
- Students shall aware of the permissible limits of various pollutants from the emission of stacks with reference to source industries.

Industry specific Emission Stacks - Source Characterization- Sampling and Analysis – Sampling Ports- Treatment Trains for Particulate and gaseous pollutants removal. Source Reduction through Process modification, alternate fuels, complete combustion or incineration- Control parameters of combustion.

Particulate Removal; Theory and Types of Cyclones; Single & Multiclones- Bag Filters: Types and Materials for Bags - Design of Cyclones & Bag Filters -Electro Static Precipitators: Design, Advantages and Limitations- Energy factors- Pressure drop- Limitations – Merits &Demerits- Efficiency- Ash Disposal

Gaseous Pollutants- Theory and Types of Wet Scrubbers- Venturi Scrubber- Packed Bed Tower- Dry Scrubbers- Theory and Design Principles- Operation & Maintenance Manual- Refractory lining- Spent liquor Treatment.

Proprietary systems Equipment choices- Emission lines- Pressure drop: Monitoring & Control- Leak detection - Compliance of the choice to Mandates of Consent or Clearances- Proprietary systems

Statutory Requirements for Continuous monitoring- Primary Parameters of industry specific- Data logging systems – Data transfer and compliance.

REFERENCES

1. Lawrence K. Wang, Norman C. Parelra, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, 2004.

2. Noel de Nevers, "Air Pollution Control Engg"., Mc Graw Hill, New York, 1995.
3. David H.F. Liu, Bela G. Liptak „Air Pollution", Lweis Publishers, 2000.
4. Anjaneyulu. Y, "Air Pollution & Control Technologies" Allied Publishers (P) Ltd.,India, 2002.
5. Arthur C.Stern, „Air Pollution (Vol.I – Vol.VIII)", Academic Press, 2006.
6. Wayne T.Davis, „Air Pollution Engineering Manual", John Wiley & Sons, Inc., 2000.
7. Daniel Vallero" Fundamentals of Air Pollution", Fourth Edition,2008.

COURSE OUTCOMES

1. Students should have known the source characterization and interpretation for its control
2. Students should have become conversant on all choices of equipment for emission control and management for various particulates pollutants.
3. Students should have become conversant on all choices of equipment for emission control and management for various gaseous pollutants
4. Students will become conversant with proprietary equipment specifically with respect to type of pollutants that can be controlled and removed.
5. Students should have come to know all Permissible of various pollutants with respect to industries from the Stacks.

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2									3	2	1
CO2	2	1			3							3	2	1
CO3	1	2			3							3	2	1
CO4	1	2			3							3	2	1
CO5	1	2			3							3	2	1

23CEEEPEXX	CLIMATE CHANGE AND ADAPTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Understand the earth's climate change and to know the Institutional arrangements and existing legal frame work for monitoring this phenomenon and the role climate models.
- To understand the likely impact of climate change on various sectors and its irreversibility.
- To study and to evolve suitable adaptation and mitigation measures of climate change on various sectors and to know the importance of climate planning.

Introduction to climate change science

Basics of climate change - climate - weather and the greenhouse gas effect - Earth's climate machine - hydrological cycle - ocean circulation - natural cycles - human contribution to climate change - observed changes in the climate since the industrial revolution - projected future trends and impacts of climate change on surface temperature - precipitation - ocean pH - sea-level and Arctic sea-ice extent - its effects - sources of scientific climate information - relevant programs - role / functions of various institutions.

International / National policy framework to address Climate Change

History of international climate change negotiations and United Nations Framework Convention on Climate Change (UNFCCC), key provisions of the UNFCCC, its organizational structure, different party under the Convention, Kyoto Protocol - its associated bodies, key commitments by Parties. Key issues relevant for a future climate change regime, Montreal Protocol – Climate conventions, IPCC – role, structure and functions – assessment reports – Evidences of Change in Climate and Environment– on a Global Scale /India– policy frame work and initiatives by India., climate change predictions – Climate Change models.

Likely impact and Adaptation to Climate Change

Impact of Climate Change on various sectors– Agriculture, Forestry and Eco-system– Water resources– Human Health– Industry, Society–Scenarios –Projected Impacts for different regions, Introduction to climate change adaptation, ways to measure

vulnerability, examples of adaptation, solutions, planned response, framework for assessing climate vulnerability, adaptation measures for various vulnerable sectors.

Climate change Mitigation

Strategies to bring down emissions to safe levels, emission levels and mitigation targets, mitigation through development planning, key international mechanisms to assist countries in planning and implementing mitigation actions, Carbon sequestration– Carbon Capture and Storage, carbon foot prints, Carbon Trading, Alternative fuels, CDM, MDG and SDG's.

Introduction to Planning for Climate Change

Planning processes for climate change - climate change planning – at national level – sectoral -sub-national institutions in climate change planning - five-step methodology for preparing a low-emission climate-resilient development strategy - international initiatives to support climate change planning.

REFERENCES

1. Alcore' Inconvenient Truth"–video form
2. DashSushilKumar,"Climate Change– An Indian Perspective", Cambridge University PressIndiaPvt.Ltd,2007
3. IPCC Fifth Assessment Report (AR5)–www.ipcc.ch
4. JanC.vanDam,Impactsof"ClimateChangeandClimateVariabilityonHydrological Regimes",CambridgeUniversityPress,2003
5. Cambridge University (2013). Climate Change: Action, Trends and Implications for Business.
6. IISD, UNITAR & UNEP (2009). IEA Training Material: Vulnerability and Climate Change Impact Assessment for Adaptation.
7. IPCC (2013). Climate Change 2013. The Physical Science Basis - Summary for Policymakers.
8. OECD (2009): Guidance on Integrating Climate Change Adaptation into Development Co-operation.
9. UNEP (2009). Climate Change Science Compendium
10. UNEP (2009). Climate in Peril, a Popular Guide to the Latest IPCC Report.
11. UNEP & UNDP (2011). Mainstreaming Climate Change Adaptation into Development Planning: A Guide for Practitioners.
12. UNFCCC (2008). Compendium on Methods and Tools to Evaluate Impacts of, and Vulnerability and Adaptation to, Climate Change.
13. UNFCCC (2006). UNFCCC Handbook.
14. UNFCCC & UNEP (2002). Climate Change Information Kit.
15. World Meteorological Organization (2012). Greenhouse Gas Bulletins.

COURSE OUTCOMES

At the end of the course students will be able to

1. Understand the science behind the earth's climate change and its system classification.
2. Know the role and objectives of global conventions.
3. Acquire substantial knowledge on global and national level Institutional arrangements existing for monitoring the climate change.
4. Show the likely impact of climate change on various sectors and its irreversibility.
5. Understand the need for evolving strategies for adaptation mitigation measures of climate change on various sectors, Know the role and use of climate planning and cleaner technology.

Mapping of COs with POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3			2		1						3	2	1
CO2	3			2		1						3	2	1
CO3	3			2		1						3	2	1
CO4	3			2		1						3	2	1
CO5	3			2		1						3	2	1

23CEEEPEXX	AIR POLLUTION METEOROLOGY AND MODELING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To enlighten the students in the various aspects of Air pollution and associated Meteorology particularly for dispersion.
- To have the exposure of fundamentals Planetary Boundary Layer Characteristics.
- To understand the different approaches of pollutant transport theories.
- To learn the popular Gaussian Plume Model used widely for regulatory purposes.
- To provide numerical dispersion modelling for the advancement towards research and development.

Air pollution micrometeorology–primary and secondary measurement – projection-Sources of meteorological data- Planetary Boundary Layer (PBL) – Introduction and

definition–Earth and atmosphere Exchange process-Thermodynamic variables and their vertical distribution in the PBL- Atmospheric stability –lapse rate- stability classes. Conservation laws-Atmospheric dynamics – Large scale in viscid and small scale viscous flows- Application. Scales of Atmospheric motion –Macro, synoptic, Meso and Micro scale system and dispersion - Characteristic plume shapes – Inversion breakup and shoreline fumigation.

Gradient Transport Theories – Eulerian approach to describe diffusion-Mass conservation and diffusion equations- Molecular diffusion-Turbulent diffusion constant K (Fickian Diffusion) theory- Variable K-theory-Limitations and experimental verification of gradient transport theories –Application of K-theories to atmospheric dispersion

Statistical Theories of Diffusion-Lagrangian approach to describing diffusion-Statistical theory of absolute diffusion-Plume diffusion from continuous sources- Statistical theory of relative diffusion-Puff diffusion from Instantaneous Release – Fluctuating Plume Models- Experimental Verification of Statistical Theories-Application to Atmospheric Dispersion and Limitation.

Gaussian Plume Model- assumptions and approximation-Diffusion experiments- Pasquill Stability classes-Empirical dispersion parameterization schemes – Pasquill-Gifford-Brookhaven National Laboratory-Tennessee Valley Authority-Briggs Urban Dispersion-Maximum Ground Level Concentration-Model evaluation – Tracer release experiments. Plume rise theory-Briggs- Plume Concentrations for differing sampling time averaging-Gravitational Settling of Particles-Dry Deposition

Numerical Dispersion Models-Introduction-Short range gradient transport Models-Turbulent Kinetic Energy (TKE) models- Higher order closure models. Urban and regional Air Quality Models-Introduction_ Components of an air quality model – Urban Diffusion and air quality models-Regional air quality models- Applications.

REFERENCES

1. S.Pal Arya., “Air Pollution Meteorology And Dispersion”, Oxford University Press, 1999.
2. Arthur C. Stern., “Air Pollution” (Third Edition) Volume I- Air Pollutants, Their Transformation and Transport, Academic Press (An imprint of Elsevier), 2006.
3. Roland.B. Stull., “An Introduction to Boundary Layer Meteorology”, Kluwer Academic Press, London, 1993.
4. J.R.Garratt, “ The Atmospheric Boundary Layer”, Cambridge University Press, 1999.

5. D.Bruce Turner, "Workbook of Atmospheric Dispersion Estimates", Lewis Publishers, London, 1994.
6. Lyons, T.J., and Scott, W.D., "Principles of Air Pollution Meteorology", CBS Publishers and Distributors (P) Ltd., New Delhi, 1992.
7. James R. Holton, "An Introduction to Dynamic Meteorology", Academic Press Inc., London, 1989.

COURSE OUTCOMES

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

1. The concepts of micrometeorology and fundamentals and atmospheric attributes.
2. Model the transport, diffusion and dispersion of pollutants.
3. Gaussian or numerical methods with better air pollution meteorological background.
4. Numerical Modelling and interpretation for predicted GLC of pollutants.
5. Investigate the present existing regulatory models and Urban air quality

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3			2								3	2	1
CO2	1			2	3							3	2	1
CO3	1			2	3							3	2	1
CO4	1			2	3							3	2	1
CO5	1			2	3							3	2	1

23CEEEPEXX	**REMOTE SENSING AND GIS**	L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To learn the principles and applications of spatial information technologies namely remote sensing, GPS and GIS in the context of Environmental Engineering.
- To realize the importance of remote sensing and GIS in solving the spatial problems in Environmental Engineering.

Concepts of Remote Sensing – Principles of remote sensing - Energy sources and radiation principles, Energy interactions with atmosphere, Energy interactions with earth surface features - Spectral reflectance of some earth features- Data acquisition and

interpretation –Aerial photography – Visible, Infra Red and Microwave sensing-Thermal and Multispectral remote sensing.

Classification of sensing system - Active and Passive- Remote sensing platforms-Sun synchronous and Geosynchronous - Image interpretation - Visual Image Interpretation - Digital Image Processing – Image rectification, enhancement classification-Supervised and Unsupervised - satellite data Products-Concepts of GPS.

GIS- Definition- basic components of GIS-standard GIS packages-Maps-Mapping process- projections, coordinate systems-Spatial data –spatial data model-spatial relationship-topology-spatial data structure: Raster, Vector – attribute data- database-database management systems-database models: Hierarchical, network, relational, object oriented models-data input, editing-integrated GIS database.

Thematic mapping - measurement in GIS: length, perimeter and areas - Query analysis - Reclassification-Buffering-Neighborhood functions-Integrating data: map overlay, overlay functions, vector overlay and raster overlay – Interpolation-Network analysis-Data output types- Output devices-Error- Types of errors -Digital Elevation Modeling (DEM).

Application of remote sensing - Management and monitoring of Environment, conservation of resources, coastal zone management – Limitations – urban storm water studies – Solid waste management – optimal routing – wetland studies – non point source pollution -water Quality, monitoring and management.

REFERENCES

1. Lillesand, T.M. and Kiefer, R.W., “Remote Sensing and Image Interpretation”, John Wiley and Sons, New York, 2004.
2. Burrough, P.A. and McDonnell, R.A., “Principles of Geographic Information Systems”, Oxford University Press, New York, 2001.
3. Lintz, J. and Simonet, “Remote Sensing of Environment”, Addison Wesley Publishing Company, New Jersey, 1998.

COURSE OUTCOMES

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

1. Understand the concepts and application of Remote sensing, GIS and GPS.
2. Apply the various methods of Visual Interpretation and Digital image interpretation.

3. Understand data compilation and various methods of Mapping process
4. Understand various thematic map, Map overlay and DEM.
5. Apply the RA/GIS techniques for resources management.

Mapping of COs with POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1			2	3							3	2	1
CO2	1			2	3							3	2	1
CO3	1			2	3							3	2	1
CO4	1			2	3							3	2	1
CO5	1			2	3							3	2	1

23CEEEPEXX	OPERATION AND MAINTENANC OF EFFLUENT TREATMENT PLANTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To educate the student on the various Operation & Maintenance aspects of Water treatment systems, sewer systems, sewage treatment plants and Effluent Treatment Plants.

Elements of operation and maintenance: Process and equipment- Preventive and Corrective maintenance scheduling- - Operation and Maintenance Plan - Proper and adequate tools, Spare units and parts - Training Requirements.

Laboratory control- Records and Reports- Housekeeping - Corrosion prevention and control –Sampling procedure-Analytical techniques- Measurement of Flows, Pressures and Levels -Safety in O&M Operations - Management Information System - Measures for Conservation of Energy- management of residues from plant maintenance.

Operation and maintenance of Physico-Chemical Treatments: Operation and maintenance in screen chamber, Grit Chamber and clarifiers- - Operation issues, trouble shooting guidelines and record keeping requirements for clarifier, Equalization basins, Neutralization unit - Chemical storage and mixing equipment - Chemical metering equipment - Flash mixer –Filters, thickeners and centrifuges- Filter Press - Start-up and maintenance inspection - Motors and Pumps - Hazards in Chemical Handling – Jar Test - Chlorination Equipment - Membrane process systems- SDI and LSI determination- Process Chemistry and Chemical dosage calculations- Case Studies.

Operation and Maintenance of Biological Treatment: Construction, Operation and Maintenance aspects of activated sludge process, trickling filters, anaerobic digester, SBR, UASBR, MBRs- Startup and Shutdown Procedures-DO, MLSS and SVI monitoring.

Organizational Set up : Protocol & Procedure- Personal Safety Systems- Trouble shooting guidelines – Interaction with other Treatment Processes - Planning, Organizing and Controlling of plant operations – capacity building, case studies of Retrofitting- Case studies.

REFERENCES

1. CPHEEO, Manual on operation and maintenance of water supply systems, Central Public Health and Environmental Engineering Organisation, Ministry of Urban Development, Government of India, 2005.
2. Ministry of Drinking Water and Sanitation, operation and maintenance manual for rural water supplies, Government of India, 2013.
3. Metcalf & Eddy, Inc., G. Tchobanoglous, H. D. Stensel, R. Tsuchihashi, and F. L.Burton. "Wastewater Engineering: Treatment and Resource Recovery"5th edition). McGraw Hill Company, 2014.
4. Ananth S Kodavasal, The STP Guide-Design, Operation and maintenance, Karnataka State Pollution Control Board, Bangalore, 2011.
5. FrikSchutte, Handbook for the operation of water Treatment Works, The Water Research Commission, The Water Institute of Southern Africa, TT265/06, 2006.

COURSE OUTCOMES

At the end of the course students will be able to

1. Acquire knowledge on the protocols and parameters of operation and maintenance Effluent treatment plants.
2. Gain knowledge on parameters of analysis and laboratory techniques
3. Parameters specific to unit operations and the respective limiting values for Physico Chemical treatment plants.
4. Parameters specific to unit operations and the respective limiting values for biological treatment plants.
5. Augmentation methodologies and trouble shooting.

Mapping of COs with POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3		2	1								1	2	3
CO2	3		2		1							2	3	1
CO3	3		2		1							3	2	1
CO4	2			1					3			1	2	3
CO5	2			1					3			2	3	1

23CEEEPEXX	LANDFILL ENGINEERING & REMEDIATION	L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To understand the important characteristics and design principles of the waste containment and remediation industry.
- To know the relevant regulations and engineering design requirements of landfills and contaminated site remediation.

Landfill: Waste management Hierarchy- Need for landfills –Environmental Protection by Landfills- Landfill Classification – Sanitary and Secure Landfills - Components and Configuration - Legal framework for land filling – Landfill Site investigation- Regional Landfills- Environmental control using site design –- Landfill Design Tasks

Landfill Liners and cover systems: Landfill barrier system components – Design of Compacted clay liners: Factors affecting hydraulic conductivity , Water content-density criteria, Thickness, Desiccation - Geo synthetic Clay Liners and Geo membranes; types, manufacturing, handling, seaming and testing - Asphalt Barriers and Capillary barrier - Composite Liner system design- liner construction and quality control- Leakage through Liners- vapor transmission and chemical compatibility - Installation of Geo membranes - Liner Leakage Mechanism – Diffusion - Controls on advection through liners - Single phase flow-advection-diffusion- Landfill cover systems- Design of Cover Systems – Daily Cover – Intermediate Cover – Final Cover - Flow through Landfill Covers- Design and Analysis of Slope Stability- Anchor Trenches- Access ramps - Erosion control

Leachate and Landfill Gas Management: Waste decomposition in landfills - Factors affecting leachate and landfill gas generation – Factors affecting Leachate Quantity in active and post closure conditions- Hydrologic Evaluation of *Landfill* Performance (HELP) model – Leachate Drainage Layer – Geotextile and Geonet design – Leachate Collection and Removal systems-Temporal trends in leachate composition – Design of

Landfill gas collection and removal systems- Gas condensate issues & knockouts - Leachate treatment methods (biological and physico-chemical)- Leachate re-circulation & bioreactor landfills- monitoring and control of leachate and Landfill gas- Landfill Settlement

Landfill Operation and Closure: Landfill Construction and Operational Controls – Fill Sequencing Plans – Cell Construction- Dozer and Compactor operations-Selection of Landfill Equipment- Landfill Administration-Record Keeping - Topographic mapping.

Environmental Controls – Odour, Vector and Litter Control – Landfill Safety - Fire Control – Ground and Surface water Monitoring – Methane Gas monitoring - Audits of landfill environmental performance and management – Post Closure care and use of landfills – Landfill Economics- landfill construction and operational cost estimation – Rehabilitation of Open dumps- Landfill Mining.

REFERENCES

1. Robert M. Koerner and Donald H Gray "Geotechnical aspects of Landfill Design and Construction", Prentice Hall, New Jersy, 2002.
2. Neal Bolton P.E “The Handbook of Landfill Operations”, Blue Ridge Services Inc., Atascadro, CA, 1995.
3. David E Daniel and Robert M. Koerner “Waste Containment Facilities –Guidance for construction Quality Assurance and Construction Quality Control of Liner and Cover Systems”, American Society of Civil Engineers, ASCE Press, 2007.
4. Donald L Wise and Debra J Trantolo, “Remediation of Hazardous Waste Contaminated Soils”, Marcel Dekker Inc., New York, 1994.
5. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management”, Mc-Graw Hill International edition, New York, 1993.
6. Hari D Sharma and Krishna R. Reddy, “Geo-environmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies”, John Wiely, New Jersy, 2004.
7. Oweis, I.S. and Khera, R.P, “Geotechnology of Waste Management”, 2nd Edition, PWS Publishing Co., Boston, MA, 1998.

COURSE OUTCOMES

At the end of the course students will be able to

1. Have an overview of the Indian and International landfill regulations and guidelines for the design, construction, operation and management of landfills.
2. Use of Membranes and liner systems
3. Understand the methods for management and treatment of landfill gas and leachate.
4. Operation and Closure Post closure monitoring requirements.
5. Post closure monitoring requirements and monitoring schedules.

Mapping of COs with POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3											3		
CO2					2							3		
CO3		3										3		
CO4	3											3		
CO5	3											3		

23CEEEPEXX	NOISE POLLUTION AND CONTROL	L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To give students an overview of noise pollution including methods of prevention, control, measures and management of pollution.
- To apply the theory of noise pollution to practical engineering situations.
- To use engineering instrumentation and principles to undertake a laboratory investigation in noise pollution.

Sources of Noise: Industry, Road traffic, Rail traffic, Air traffic, Construction and Public Works, Indoor Sources, Public Gatherings

Effects of Noise: Human hearing mechanism, Interference with Communication, Hearing Loss, Disturbance of sleep, Stress, annoyance, Effects of performance, Miscellaneous effects, Exposure limits

Basic Concepts of Sound: Propagation of Sound Wave Sound Intensity and Sound Power, Sound level and decibel, equivalent and continuous sound pressure level

Sound Measurement: Sound level meters, Types, Components, Community Noise Measurement, Procedure

Noise Pollution Control: Community and Industrial Noise, Control Measures, Control at Source, Control of sound transmission, Reduction in Length of exposure, Education of Public and Workers, Ear Protection, Noise Pollution Control Legislation

REFERENCES

1. “Environmental Health Criteria – 12”, Noise, World Health Organisation Publication, Geneva, 1980.
2. Patrick, C.F., “Environmental Noise Pollution ", John Wiley and Sons, 1977.
3. Burs, W., LippinCott., " Noise and Man", Philadelphia, 1969.

COURSE OUTCOMES

At the end of the course students will be able to

1. Overview noise pollution sources
2. Impacts of Noise Pollution
3. Noise Propagation
4. Methods of Noise Measurement.
5. Methods for prevention and control.

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3											3		
CO2	3													3
CO3	3											3		
CO4			3									3		
CO5			3											3

OPEN ELECTIVES

23CEEEOEXX	STATISTICS FOR ENVIRONMENTAL RESEARCH	L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To provide commonly used hypothesis tests, present univariate statistical methods, provide methods for gaining a preliminary understanding of a multivariate data base.
- To summarize some important concepts related to the assessment of model reliability.
- To discuss the commonly used bivariate and multivariate regression methods, spurious modelling, and contrasting methods for calibrating multivariate models, stepwise regression, PCRA.
- To introduce the basics of times series and stochastic modelling.

Introduction: Statistical decision making – Definition of a model – The Modelling process Hypothesis Tests on Means: The Analysis of Variance problem – Objective – One-sample and Two – sample t Tests – One-Way ANOVA – Multiple comparisons in the ANOVA test – Randomized Block Design – Two-Way ANOVA; Hypothesis Tests of Variances: One-sample χ^2 test – Two sample F test – Barlett's test for group variances. *Frequency Analysis*: Probability paper – plotting the data – Fitting Normal, Log-Normal and Log-Pearson Type-III distributions – Low-flow frequency analysis – Binomial risk

Nonparametric Methods: One-sample run test for randomness – Pearson test and Spearman tests for serial dependence – Durbin-Watson test for autocorrelation – Kendall test for trend – Mann-Whitney test for distribution inequality – Chi-square test for goodness of fit – Kolmogorov – Smirnov One-sample and Two-sample tests. *Assessing Model Reliability*: Model rationality – Bias in estimation – SEE – Correlation coefficient – Accuracy of model coefficients – Analysis of the residuals

Correlation and Regression Analysis: Bivariate correlation – correlation in multivariate systems; Bivariate linear regression – statistical optimization – principle of least squares – reliability of the regression equation – reliability of point estimates of regression coefficients – confidence interval of the regression equation – correlation versus regression

Multiple Regression Analysis: Matrix solution of the standardized model - criteria for evaluating a multiple regression model – Analysis of residuals Spurious Correlation and Regression: Transformation of a bivariate regression equation – Transformation involving ratios of variables – the ratio correlation problem – ratio correlation cases;

Stepwise Regression: Objective – model structure – Total and partial F tests Principal components Regression Analysis – PCRA method; Polynomial regression analysis: Transformation and calibration – Analysis of variance of polynomial models – PCRA of polynomial equations

Numerical Optimization: Nonlinear model structures – objective function – response surfaces – Phase I search – Step sizes – Constraints – Goodness of fit - Calibration of power models – criteria for measuring optimality. *Time Series and Stochastic Modeling*: Components of a Time Series – Moving-Average filtering – Autocorrelation analysis – Cross-correlation analysis – Identification of random component – Auto regression and Cross-regression models

REFERENCES

1. Gupta, S.C. and Kapoor, V. K., "Fundamentals of Mathematical Statistics", Eleventh Edition (Reprint), Sultan Chand & Sons, 2014
2. Richard H McCuen, "Statistical Methods for Engineers", Prentice-Hall, Englewood Cliffs, N.J., 1985
3. Richard H McCuen, "Microcomputer Applications in Statistical Hydrology", Prentice-Hall, Englewood Cliffs, N.J., 1993
4. Vic Barnett, "Environmental Statistics: Methods and Applications", John Wiley & Sons, Inc., 2003
5. Gupta, S.C. and Kapoor, V. K., "Fundamentals of Applied Statistics", Fourth Edition (Reprint), Sultan Chand & Sons, 2014
6. Richard H McCuen and Willard M Snyder, "Hydrologic Modelling: Statistical Methods and Applications", Prentice-Hall, Englewood Cliffs, N.J., 1986
7. Paul Mac Berthouex and Linfield C. Brown, "Statistics for Environmental Engineers", Second Edition, Lewis Publishers, Washington D.C. , 2002

COURSE OUTCOMES

At the end of the course students will be able to

1. Recognize that statistical methods are decision-making tools and will view them as a part of a process.
2. Demonstrate different examples to illustrate each statistical method, recognizing that there are a great many possible applications of statistical methods.
3. Explore the use of statistical software and develop microcomputer applications for solving real-time problems in Water Resources Engineering and Environmental Engineering.
4. Realize that the course contains the statistical methods necessary to solve a wide array of real-world problems in Water Resources Engineering and Environmental Engineering.
5. Conversant on statistical tools for analysing environmental data and apply for research and development projects.

Mapping of COs with POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1		2		3							1	2	3
CO2	1		2		3							2	3	1
CO3	1		2		3							3	2	1
CO4	1		2		3							2	3	1
CO5	1		2		3							1	2	3

23CEEEOEXX	MARINE POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To educate about the Coastal and Marine Environment.
- To expose the concepts of Marine disposals and ocean dynamics.
- To find sources of marine pollution and methods for monitoring and control.

Marine and Coastal Environment: Seas and oceans, Continental area, Coastal zone, Properties of seawater, Principles of Marine Geology, coastal features–Beaches, Estuaries, Lagoons–The oceans and climate

Ocean Hydrodynamics: Wave Theory, Waves in shallow waters–Refraction, Diffraction and Shoaling, Approximations for deep and shallow water conditions– Tidal Classification- General circulation of ocean waters- Ocean currents-Coastal sediment transport- Onshore offshore sediment transport - Beach formation and coastal processes - Tsunamis, storm surge, El Niño effect.

Marine Pollution sources and effects: Sources of Marine Pollution–Point and non-point sources, Pollution caused by Oil Exploration, Dredging, Offshore Structures, Agriculture Impacts of pollution on water quality and coastal eco systems –Marine discharges and effluent standards.

Marine Pollution Monitoring: Basic measurements-Sounding boat, lead lines, echo sounders – current meters – tide gauge- use of GPS – Measurement of coastal water characteristics – sea bed sampling – Modeling of Pollutant transport and dispersion-Oil Spill Models – Ocean Monitoring satellites – Applications of Remote Sensing and GIS in monitoring marine pollution

Coastal Management: Pollution Control strategies – Selection of optimal Outfall locations - National and International Treaties, Coastal Zone Regulation–Total Maximum Daily Load applications – Protocol sin Marine Pollution– ICZM and Sustainable Development

REFERENCES

1. R.B. Clark, C. Fridand MAtttrill, "Marine Pollution", Oxford Science Publications, 5th Edition,2005.
2. TobiasN. Hofer, "Marine Pollution:NewResearch", Nova Publishers,2008
3. Dr.P.C.Sinha , "Marine pollution", Anmol Publications Pvt.Ltd, 1998.
4. Laws,E.A., "Aquaticpollution", JohnWileyandSons, Inc., NewYork, 2000.
5. Michael J.Kennish, "Practical HandbookofEstuarineandMarine Pollution",Volume10ofCRC Marine Science,CRC Press, 1996.

COURSE OUTCOMES

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

1. Know about marine environment and earn the physical concept the oceanic currents and natural processes of various activities happening over the marine environment.
2. Acquire knowledge on the marine pollution and the effect of the same on the ecology.
3. Understand remote sensing and various other techniques for measuring and monitoring oceanic environment parameters.
4. Learn the significance of control of marine pollution and sustainable development.
5. Understand the importance of ICZMP and the need of its implementation.

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3				1	2						3	2	1
CO2	3				1	2						3	2	1
CO3	3				1	2						3	2	1
CO4	3				1	2						3	2	1
CO5	3				1	2						3	2	1

23CEEEOEXX	ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	C
		3	**0**	**0**	**3**

COURESE OBJECTIVES

- To study the living organisms of microscopic size, which in clued bacteria, fungi, algae, protozoa and the infectious agents and their form, structure, reproduction, physiology, metabolism and classification.
- To study their distribution in nature, their relationship to each other and to other organisms, their effects on human beings and on other animals and plants, their abilities to make physical and chemical changes in our environment, and their reactions to physical and chemical agents.

Cellular structure of microorganism, classification and study of microorganisms, nutrition of microorganisms and metabolism, enzymes, photosynthesis, protein, fat and carbohydrate metabolism, respiration sterilization theory, growth kinetics and enzyme kinetics, modelling aspects of microbial growth and metabolism

Ecology and ecosystem, spoilage and product manufacture by spontaneous mixed cultures, microbial participation in the natural cycles of matter

General features of the organic and inorganic pollutants; Bacteriology of water, sewage, air, soil and milk - Algae in water supply and its control, microbiology of waste water treatment - Bio-methanation processes

Agricultural applications for sludge and wastewaters – process design schemes for treatment of wastewater – dumping of refuge and sludge – exhaust gas purification Some case studies of treatment of effluents from distillery, refinery, fertilizer, tannery textile, pulp and paper and metal processing industries

REFERENCES

1. Atlas, R.A. and Bartha, R. "Microbial Ecology- Fundamentals and Application", Benjamin Cummings, New York, 2000.
2. Grant,Wd.AndLong,PL., "Environmental Microbiology", Blackie Glasgow, London, 1981.
3. Grerard J. Tortora, Berdell R.Funke, ChristineandL. Case, "Microbiology: An Introduction", Benjamin Cummings, U.S.A.2004.
4. Pelczar Jr.MJ, Chan EC SandKrieg, NR., "Microbiology", Mc Graw HillInc., NewYork, 1993.

5. Prescott, L.M., Harley, J.P. and Klein, D.A., "Microbiology", Mc Graw Hill, New York,2006.
6. H.J. Rehm and G.Reed., "A Comprehensive treatise in Biotechnology" Vol. No.8., Verlag Chenie, Wein Heim, 1983.
7. M.J.Pelczar, R.D. Reid and F.C.S. Chan, "Microbiology", Tata Mcgraw Hill Publishing Co., 1977.

COURSE OUTCOMES

At the end of the course students will be able to

1. Understand the characteristics and role of microbes in sustenance of life systems..
2. Isolate and identify different microbes present in various sources.
3. Acquire knowledge on soil, aquatic and air microbiology.
4. Become acquainted with role of microorganisms in the waste treatment
5. Become conversant in applying the microorganisms in the treatment processes and plants.

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		3										3		
CO2			2										3	
CO3	2											3		
CO4		3											3	
CO5				3									3	

23CEEEOEXX	**SUSTAINABLE DEVELOPMENT AND CIRCULAR ECONOMY**	L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES

Students shall be taught to appreciate the need for managing the natural resources to ensure the sustainability of our developmental works with the following specific studies;

- Identify and critically discuss the connection between linear/circular economies and environmental sustainability generally and between circular economies and SDG 12 specifically

- Identify and critically discuss the histories, concepts, business models, goals and scopes for circular economies
- Couple insights in circular economic thinking based on business models and guest lectures given by practitioners with theoretical readings
- Identify and discuss ideas for transitions to circular economies
- Identify and discuss advantages and limitations of circular economies

Introduction

Linear economy- General principles of sustainability and the SDGs- Principles of Circular Economies – Life Cycle Analysis- Biomimicry, the sharing economy, cradle-to-cradle, and the roots/genealogies - conceptual frameworks of circular economies-.

Business Models for Circular Economy

Create value by reusing/recycling - Industrial designs provide smarter solutions- Offering products as "service" rather than selling products - Transferring ownership to consumers - Business model for Circular Economy.

Measurements and Metrics

Carbon foot print of any given product or service- Review Life Cycle Assessments - Review the case for proximity and appropriate scale in the design of production-trade-consumption networks- Case studies include biofuels from the production of palm oil and the manufacture of mobile phones.

Businesses adopting circular economy models

Businesses adopting circular economy models for specific sectors - food & agriculture, mining & minerals ,transport & cycling, fashion & textiles , consumer electricals & electronics and industrial manufacturing (furniture)

Circular economies and Development

Current Global scenario of adoption of circular economies in development economies - Transitions to Circular Economies - Economic anthropology on exchange, circulation and flows of materials in specific societies- circular economies in space and time.

TEXT BOOKS

Angelis, Roberta De (2018) Business Models in the Circular Economy: Concepts, Examples and Theory (Palgrave)

Weetman, Catherine (2016) A Circular Economy Handbook for Business and Supply Chains (Kogan Page)

REFERENCES

1. United Nations Sustainable Development Goals (2015)
2. The Age of Sustainable Development, Sach,2015

COURSE OUTCOMES

At the end of the course students will be able to

1. Understand the conceptual framework of circular economy
2. Understand the business models for circular economy
3. Understand the importance of carbon foot print and life cycle assessment
4. Acquire knowledge on Business adoption circular economy models of adaptation
5. Understand circular economy and development over Global scenario

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1						1	3		2			3	2	1
CO2						1	3		2			3	2	1
CO3						1	3		2			3	2	1
CO4						1	3		2			3	2	1
CO5						1	3		2			3	2	1

23CEEEOEXX	**ENVIRONMENTAL LEGISLATION**	L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To understand the importance of Environmental Policy Frameworks of National and International Conventions.
- To understand and appreciate the Legislation in this Country for Prevention ands Control of Industrial Pollution and Environmental Protection.

Environmental Polices and Legislations – Regulations to Encourage Pollution Prevention and Cleaner Production – Regulatory versus Market-Based Approaches.
Ministry of Environment, Forests& Climate Changer- Environmental Protection Act- Rules for Water and Air Pollution Control and Management- Notifications for Environmental Impact Assessment- Notifications for Coastal Zone Management and amendments thereof- Specific Rules for Solid Waste Management – Noise Control.

Special Notifications on Reserved Forests and Biospheres – Marine Biodiversity – Endangered Species- Green Belt Development – Forest Cover.

Central Pollution Control Board- Pollution Control Boards and Committees- State Environmental Impact Assessment Authorities- State Coastal Zone Management Authorities- EAC and SEAC – District Environmental Committees- Public Hearing Issues- Environmental NGOs.

International Framework Conventions on Climate Change- IPCC- Life Cycle Assessment and Environmental Management Systems: Elements of LCA – Life Cycle Costing – Eco Labeling – International Environmental Standards – ISO 14001 – Environmental audit, Green building & green energy concepts and management.

REFERENCES

1. Modak, P., "Waste Minimization: A guide to cleaner production and Enhanced profitability", Centre for Environmental Education, Ahmedabad, 1996.
2. Modak, P., C. Visvanathan and MandarParasnis "Cleaner production Audit, Environmental systems Reviews", Asian Institute of Technology, Bangkok, 2005.
3. Paul L Bishop, "Pollution Prevention: Fundamentals and Practice", McGraw Hill International, 2000.
4. World Bank Group, "'Pollution Prevention and Abatement Handbook – Towards Cleaner Production", World Bank and UNEP, Washington D.C., 2005

COURSE OUTCOMES

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

1. Appreciation on International and National Acts and Rules for Environmental Protection.
2. Understand and become conversant key legislation on Environmental Protection in India.
3. Gain knowledge on Various Notifications and Guidelines on Forests, Biosphere and Green Belt Development.
4. Understand and become conversant on nodal governmental agencies on Environmental Protection in India.
5. Understand and become conversant on International Conventions and legal Frameworks for Environmental Protection.

Mapping of COs with POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2								1	3		1	2	3
CO2	2								1	3		2	3	1
CO3	2								1	3		3	2	1
CO4	2								1	3		2	3	1
CO5	2								1	3		1	2	3

23CEEEOEXX	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

COURESE OBJECTIVES

- To understand the importance of Composite Materials as a subject that revolutionized modern day technologies.
- To understand the significance of material science in the development of new materials and devices for all branches of Engineering.

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.

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

Isostrain and Isostress conditions.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. Manufacturing of Polymer Matrix Composites: Preparation of Molding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression molding – Reaction injection molding. Properties and applications.

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.

TEXT 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.

REFERENCES

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.

COURSE OUTCOMES

At the end of the course students will be able to

1. Understand the Composite materials and their specific characteristics.
2. Become conversant with engineering properties of the composite materials
3. Understand the basis of manufacturing processes and techniques for composite materials.
4. Understand the basis of advanced manufacturing processes and techniques for composite materials.
5. Become conversant with analysis techniques to assess the strength of the composite materials.

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3								1			3		
CO2	3	3							1			3		1
CO3	3	2		3			2		1		1	3	1	2
CO4	3	3		3	2	2	2		1		1	3	3	2
CO5	3	3	2	3	3		2		1	2	1	3	3	3

23CEEEOEXX	BUSINESS ANALYTICS	L	T	P	C
		3	0	0	3

COURESE OBJECTIVES

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

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

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.

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.

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.

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.

REFERENCES

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.

COURSE OUTCOMES

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive
   modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.
5. Students will become conversant on required business analytical skills

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1			1	2	3							1	2	3
CO2			1	2	3							2	3	1
CO3			1	2	3							3	2	1
CO4			1	2	3							1	2	3
CO5			1	2	3							3	2	1

23CEEEOEXX	INDUSTRIAL SAFETY	L	T	P	C
		3	**0**	**0**	**3**

COURESE OBJECTIVES

- Students to know the Standards and Guidelines for Workplace safety for all inmates and also people outside the premises.
- Personal Safety Systems to safe guard the workers from Occupational health hazards
- System specific Protocols and Procedures for overall industrial safety

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, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

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.

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.

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.

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

REFERENCES

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.

COURSE OUTCOMES

1. Students will demonstrate knowledge Safety measures and personal safety systems
2. Students will know the National and International Practices for Industrial Safety.
3. Students will become conversant with Codes and specific of Safety Systems
4. Students will come to know the analytic techniques of failures and vulnerability
5. Students will become conversant on maintenance methods for safe working environment.

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1				2		3		2		2		3
CO2	3		2			1	3	3		2	3	2		
CO3	2		2			1	1					2		
CO4	2		2	2	1	2	1		2				2	
CO5	2	1	2	2	2	2	1	1		2	1		2	2

23CEEEOE32	**OPERATIONS RESEARCH**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- Students to understand and gained the skill to apply all optimization techniques and Models
- Students to understand on working with CPM and PERT
- Students to know the methodologies of Scheduling and Sequencing.

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

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

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

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

REFERENCES

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 Optimization: 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.

COURSE OUTCOMES

At the end of the course, the student should be able to;

1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out CPM/PERT analysis
4. Student should able to model the real world problem and simulate it.
5. Students should become conversant with techniques of optimization.

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1			3	2	1							1	2	3
CO2			3	2	1							2	3	1
CO3			3	2	1							3	1	2
CO4			3	2	1							2	3	1
CO5			3	2	1							1	2	3

23CEEEOE32	COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- Students to gain the knowledge and skill to work on data base for operation control
- Students to gain the knowledge and skill to apply Cost Behavior and Profit Planning
- Students to gain the knowledge on TQM and its value in Cost management

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.

Project: meaning - Different types - why to manage - cost overruns centers - various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical 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

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 profit ability pricing decisions including transfer pricing.

Quantitative techniques for cost management - Linear Programming - PERT/CPM – Transportation Problems - Assignment problems - Simulation - Learning Curve Theory.

REFERENCES

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.

COURSE OUTCOMES

At the end of the course, the student should be able to

1. The cost management methodologies using technology options and financial management
2. Appreciate the importance of TQM and tools to apply the same in any organization.
3. Understand and become able to do several approaches of Cost Benefit Analysis.
4. Understand and become able to do several approaches of Budget Control.
5. Understand and become able to do CPM/PERT exercises for business management.

Mapping of COs with POs												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1							3					3		
CO2			3									3		
CO3	3											3		
CO4					2							3		
CO5	3											3		

23CEEEOEXX	**WASTE TO ENERGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- Students to understand the ways and scientific means to reclaim energy from the waste
- Students to understand the importance of source segregation for effective processing of waste in WTE system. Students to know all technological options of WTE.

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digesters – Need for WTE for MSW Management.

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yield sand application – Manufacture of pyrolytic oils and gases, yields and applications -Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Biomethanization Plant-Dual Fuel Burners.

Combustion: Mass Burning Incinerators- Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors-Pyrolytic Incinerators- Operation of all the Thermal Systems of WTE.

Integrated Solid Waste Management Facilities: Segregation – Resource Recovery-Modular Processes of Incinerators – Advanced systems of Biomethanization- Integrated Systems with combination of plant operations.

MSW to energy conversion - Biomass energy programs in India- Global Status of WTE-Pollution Problems- Costing – Operating feasibility- Power Purchase or Resource Management- Indian legislation and Policies. .

REFERENCES

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, TataMcGraw 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.

COURSE OUTCOMES

At the end of the course, the student should be able to

1. Students should have been understood the importance of Energy reclamation from Waste.
2. Students should have been understood all technological options of WTE including some proprietary systems as case studies.
3. Students should become conversant on Biological approach and options of WTE Technologies
4. Students should become conversant on Thermal methods of WTE Plants.
5. Students will become aware on the Indian Scenario of WTE for MSW Management.

Mapping of COs with POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3		2		1							1	2	3
CO2	3		2		1							2	3	1
CO3	3		2		1							3	1	2
CO4	3		2		1							2	3	1
CO5	3		2		1							1	2	3

AUDIT C OURSES

23CEEEACXX	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a title to ensure the good quality of paper at very first-time submission

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 Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

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, and 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.

SUGGESTED STUDIES

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. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

COURSE OUTCOMES

At the end of the course, the student should be able to

1. Students should have learnt and got the writing skills and level of readability
2. Students should have understood on when and what to write and how.
3. Students should acquire specific skills to write abstract and literature review.
4. Students should acquire specific skills to results & Conclusions.
5. Students should have been conversant with phrases when it is first time submission.

23CEEEACXX	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

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

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, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease And Epidemics, War and Conflicts.

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. 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.

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.

Disaster Mitigation: Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

SUGGESTED READINGS

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.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.

COURSE OUTCOMES

At the end of the course;

1. Students should become conversant with protocols of Risk Assessment and Disaster Management Plan.
2. Students should have understood the disaster risk reduction and humanitarian response policy
3. Students should have understood the disaster management approaches, planning and programming.
4. Students should have understood the Risk Assessment and Reduction approaches, planning and reporting.
5. Students should become conversant with Indian Protocols and Guidance documents for preparing RA and DMP.

23CEEEACXX	SANSKRIT FOR TECHNICAL KNOWLEDGE	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Alphabets in Sanskrit - Past/Present/Future Tense /Simple Sentences.
Order - Introduction of roots -Technical information about Sanskrit Literature.
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics.

SUGGESTED READING

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

COURSE OUTCOMES

At the end of the course, the student should be able to
1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students
4. Students should come to understand value system of history.
5. Students should become conversant to cite Sanskrit idioms in their writings.

23CEEEACXX	VALUE EDUCATION	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgments'.

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

SUGGESTED READING

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

COURSE OUTCOMES

1.Students should have gained the overall Knowledge of self-development
2.Students should have learnt the importance of Human values
3.Students should have understood the importance for developing the overall personality
4. Students should have understood the importance of association and cooperation.
5. Students should have understood the role of women.

23CEEEACXX	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.History of Making of the Indian Constitution: History Drafting Committee, (Composition& Working)

Philosophy of the Indian Constitution:

- Preamble- Salient Features

Constitutional Rights & Duties:

- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties.

Organs of Governance:

- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications

- Powers and Functions

Local Administration:

- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative,
- CEO of Municipal Corporation.
- Panchayati raj: Introduction, PRI: ZilaPanchayat.
- Elected officials and their roles, CEO ZilaPanchayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy.

Election Commission:

- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC and women.

SUGGESTED READING

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

COURSE OUTCOMES

At the end of the course, the student should be able to

1. Understand the preamble of constitution of India
2. Fare work about Fundamental right and duties
3. Understand organs of governance
4. Understand the governance of local administration
5. Acquire Knowledge on the functionalities of Election Commission

23CEEEACXX	PEDAGOGY STUDIES	L	T	P	C
		2	**0**	**0**	**0**

COURSE OBJECTIVES

- Review of Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Identify critical evidence gaps to guide the Professional & curriculum development.

Introduction and Methodology

Aims and rationale, Policy background, Conceptual framework and terminology-Theories of learning, Curriculum Teacher education conceptual framework, Research question – Overview of methodology and Searching.

Thematic overview

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum and 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.

REFERENCE

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 Curriculum Studies, 36 (3): 361-3
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Mulb-site teacher education research project (MUSTER report 1. London: DFID,.
4. Akyeampong K. Lussier K. Pryor J. Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272-282
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston Black well

COURSE OUTCOMES

1. Understand over view of pedagogy
2. Understand thematical overview of pedagogy
3. Understand effectives of pedagogy branches
4. Understand curriculum and assessment
5. Understand research Skills

23CEEEACXX	STRESS MANAGEMENT THROUGH YOGA	L	T	P	C
		2	**0**	**0**	**0**

COURSE OBJECTIVES

- To teach various types of stress and its management
- To teach stress according to YOGA
- To teach physiology of stress on ANS
- To educate stress related diseases and role of meditation and yoga on stress management

Meaning and Definition of Stress Types: Eutress, Distress, Anticipatory Anxiety, Intense Anuety and Depression Meaning of Management Stress Management

Concept of Stress according to Yoga Patanjali aphorism (PYS II 3) Avidya Asmita Anapana sati – Vipasama Meditation

Physiology of Stress on Autonomic Nervous System (ANS), Endocrine System: Hypothalamus, Cerebral Cortex and Neurohumours.

Mechanism of Stress related diseases Psychic, Pychosomatic. Sematic and Organic phase Role of Meditation & Pranayama on stress physiological aspect of Meditation Constant stress & strain, anxiety, conflicts resulting in fatigue among Executive. Contribution of Yogs to solve the stress related problems of Executive

Meaning and definition of Health - vincus dimensions of health (Physical Mental. Social and Spiritual) - Yoga and health - Yoga as therapy Physical fitness Stress central exercise Sitting meditation, Walling meditation Progressive muscular relaxation Gentle stretches and Massage

COURSE OUTCOMES

At the end of the course, the student should be able to

1) Understand types of stress and arrangement
2) Understand stress according to yoga
3) Understand physiology of stress on ANS
4) Understand stress related diseases and causes through meditation and yoga
5) Understand and practice yoga and meditation

23CEEEACXX	PERSONALITY DEVELOPMENT THROUGH LIFE SKILLS	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- To learn career and Professional skills
- To built altitude and motivation
- To understand stress arrangement capabilities
- To learn decision making and leadership qualities
- To learn importance of health and hygiene

Career and Professional Skills

Career and Professional Skills Listening Skills Reading Skills, Writing Skills, Effective Resume préparation, Interview Skills, Group Discussion Skills, Exploring Career Opportunités, Psychometric Analysis and Mock Interview Sessions Team Skills: Cognitive and Non-Cognitive Skills, Présentation Skills, Trust and Collaboration, Listening as a Team Skill, Brainstorming, Social and Cultural Etiquettes Digital Skills: Computer Skills, Digital Literacy and Social Media, Digital Ethics and Cyber Security

Attitude and Motivation

Attitude: Concept. Signifiance, Factors affecting attitudes, Positive attitude Advantages, Negative attitude Disadvantages, Ways to develop positive attitude, Difference between personalities having positive and negative attitude. Motivation: Concept, Significance, Internal and external motives Importance of self- motivation- Factors leading to de motivation, Maslow's Need Hierarchy Theory of Motivation,

Stress-management and Development of Capabilities

Development of will power, imagination through yogic life style Development of thinking, emotion control and discipline of mind through Pranayama- Improvement of Memory through méditation-Stress: meaning causes, and effects of stress in life management Stress: psycho-physical mechanism,management of stress through Yoga

Other Aspects of personality Development

Body language Problem-solving - Conflict and Stress Management - Decision-making skills Leadership and qualities of a successful leader - Character-building-Team-work-Time management-Work ethics-Good manners and etiquette.

Health and Hygiene

Heath and Hygiene Meaning and significance for Healthy Life 1 Exercise and Nutrition and Immunity. Obesity Meaning Types and its Hazards- Physical Fitness and Health Related Physical Fitness Concept, Components and Tests-Adventure Sports

SUGGESTED READING

1. Barun K. Mitra. "Personality Development & Soft Skills", Oxford Publishers, Third Impression,2017.
2. Ghosh, Shantikumar. 2004. Universal Values, Kolkata: The Ramakrishna Mission References Larry James, "The First Book of Life Skills: First Edition, Embassy Books, 2016.

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1. L.Chaito: Relaxation & Meditation Techniques, 1983
2. Michael Aegyle: Bodily Communication, Methuen, 1975
3. Mulligan J: The personal Management (handbook)
4. M.L. Kamlesh (1999). "Pychology in Physical education and Sports" Metropolitan BookCompany, New Delhi

5. Patra, Avinash, 2012. The Spiritual Life and Culture of India. London: Oxford University Press.
6. Postonjee D.M: Stress and Coping The Indian Experience,sage Publication.New
7. R.D. Sharma (1979). "Health and Physical Education" Gupta Prakashan, New
8. Shiv Khera, "You Can Win", Macmillan Books, New York, 2003.
9. Acharya Maha Pragya-Shaku ki Sadhna (Hindi medium)
10. Acharya Mahapragya- Naya manav, naya Vishwa, Adarsh Sahitya Sangh, Churu (Hindi medium)
11. Shiv Khera-Jeet Apki (Hindi medium)

COURSE OUTCOMES

1. Understand carrier and professional skills
2. Understand altitude and motivation
3. Understand stress arrangement and capabilities
4. Understand the health and hygiene