

ANNA UNIVERSITY, CHENNAI
NON- AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY
M.E. - INDUSTRIAL SAFETY ENGINEERING (R 2021)
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM

I TO IV SEMESTERS CURRICULA & SYLLABI

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I.	Possess a mastery of Health safety and environment awareness and safety management skills, to reach higher levels in their profession.
II.	Proficient safety Engineer rendering professional expertise to the industrial and societal needs at national and global level subject to legal requirements.
III.	Well communicate the information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities.
IV.	Demonstrate professional and ethical attitude with awareness of current legal issues by rendering expertise to wide range of industries.

PROGRAMME OUTCOMES (POs):

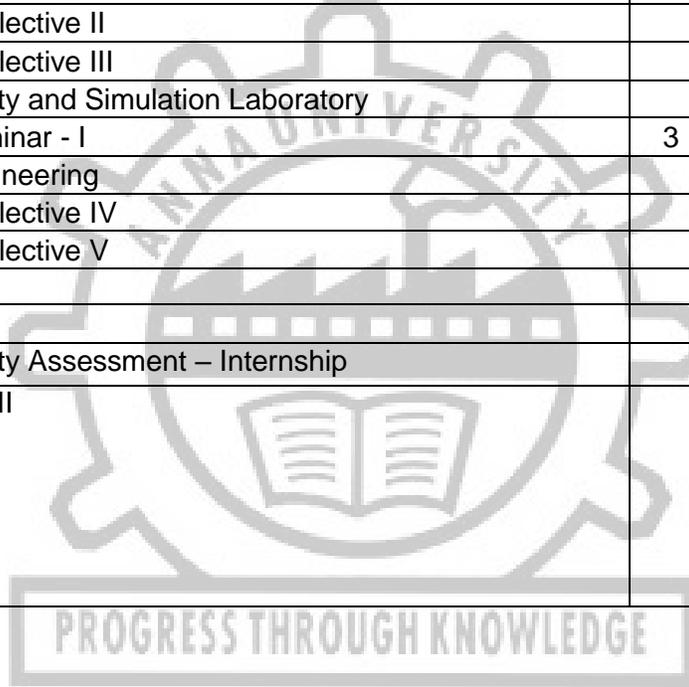
PO #	Programme Outcomes
1	An ability to independently carry out research/investigation and development work to solve practical problems
2	An ability to write and present a substantial technical report/document
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
4	Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to safety, health and environmental engineering activities with an understanding of the limitations.
5	Demonstrate the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to occupational health and safety practices.
6	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

PEO/PO Mapping:

PEO	PO					
	1	2	3	4	5	6
I.			2	3	3	
II.	2				3	2
III.	2			3	2	
IV.	2				3	2

PROGRAM ARTICULATION MATRIX OF PG - INDUSTRIAL SAFETY ENGINEERING

		COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6
YEAR I	SEMESTER I	Probability and Statistical Methods	3	2	2.5			
		Principles of Safety Management	3		2.5	2		
		Environmental Safety	3		2.5			
		Occupational Health and Industrial Hygiene	3		2.5			
		Industrial Safety, Health and Environment Acts	3		2.5			
		Research Methodology and IPR						
		Professional Elective - I						
	Safety Audit		2.5	2	3			
	SEMESTER II	Fire Engineering and Explosion Control		3	3	2	3	2
		System Simulation and Hazard Analysis		3	2	2	3	2.5
		Electrical Safety		3	2	2	3	2.5
		Safety in Process Industries		3	2	2	3	2
		Professional Elective II		2	3	3	3	2
		Professional Elective III						
Industrial Safety and Simulation Laboratory			2	3	3	3	2	
Technical Seminar - I	3				3	2		
YEAR II	SEMESTER III	Reliability Engineering		2	3	3	3	2
		Professional Elective IV						
		Professional Elective V						
		Open Elective						
		Project work -I						
		Industrial Safety Assessment – Internship		2	3		3	2
	SEMESTER IV	Project work- II						



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I TO IV SEMESTERS CURRICULA AND SYLLABUS

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA4114	Probability and Statistical Methods	FC	4	0	0	4	4
2.	IS4101	Principles of Safety Management	PCC	3	0	0	3	3
3.	IS4102	Environmental Safety	PCC	3	0	0	3	3
4.	IS4103	Occupational Health and Industrial Hygiene	PCC	3	0	0	3	3
5.	IS4104	Industrial Safety, Health and Environment Acts	PCC	3	0	0	3	3
6.	RM4151	Research Methodology and IPR	RMC	2	0	0	2	2
7.		Professional Elective - I	PEC	3	0	0	3	3
8.		Audit Course – I*	AC	2	0	0	2	0
PRACTICAL								
9.	IS4111	Safety Audit	EEC	0	0	2	2	1
TOTAL				23	0	2	25	22

* Audit Course is optional

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	IS4201	Fire Engineering and Explosion Control	PCC	3	0	0	3	3
2.	IS4202	System Simulation and Hazard Analysis	PCC	4	0	0	4	4
3.	IS4203	Electrical Safety	PCC	3	0	0	3	3
4.	IS4204	Safety in Process Industries	PCC	3	0	0	3	3
5.		Professional Elective - II	PEC	3	0	0	3	3
6.		Professional Elective- III	PEC	3	0	0	3	3
7.		Audit Course - II*	AC	2	0	0	2	0
PRACTICAL								
8.	IS4211	Industrial Safety and Simulation Laboratory	PCC	0	0	2	2	1
9.	IS4212	Technical Seminar - I	EEC	0	0	2	2	1
TOTAL				21	0	4	25	21

* Audit Course is optional

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	IS4351	Reliability Engineering	PCC	3	0	0	3	3
2.		Professional Elective - IV	PEC	3	0	0	3	3
3.		Professional Elective - V	PEC	3	0	0	3	3
4.		Open Elective	OEC	3	0	0	3	3
PRACTICAL								
5.	IS4311	Project Work I	EEC	0	0	12	12	6
6.	IS4312	Industrial Safety Assessment – Internship	EEC	0	0	4	4	2
TOTAL				12	0	16	28	20

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICAL								
1.	IS4411	Project Work II	EEC	0	0	24	24	12
TOTAL				0	0	24	24	12

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE: 75

FOUNDATION COURSES (FC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	MA4114	Probability and Statistical Methods	4	0	0	4	1

PROGRAM CORE COURSES (PCC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	IS4101	Principles of Safety Management	3	0	0	3	1
2.	IS4102	Environmental Safety	3	0	0	3	1
3.	IS4103	Occupational Health and Industrial Hygiene	3	0	0	3	1
4.	IS4104	Industrial Safety, Health and Environment Acts	3	0	0	3	1
5.	IS4201	Fire Engineering and Explosion Control	3	0	0	3	2
6.	IS4202	System Simulation and Hazard Analysis	4	0	0	4	2
7.	IS4203	Electrical Safety	3	0	0	3	2
8.	IS4204	Safety in Process Industries	3	0	0	3	2
9.	IS4211	Industrial Safety and simulation Laboratory	0	0	4	1	2
10.	IS4351	Reliability Engineering	3	0	0	3	3
TOTAL CREDITS						29	

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	RM4151	Research Methodology and IPR	2	0	0	2	1
TOTAL CREDITS							

PROFESSIONAL ELECTIVES

SEMESTER I, ELECTIVE I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	IL4076	Plant Layout and Material Handling	PEC	3	0	0	3	3
2	IS4001	Work Study and Ergonomics	PEC	3	0	0	3	3
3	IL4074	Human Factors in Engineering	PEC	3	0	0	3	3
4	IS4002	Maintainability Engineering	PEC	3	0	0	3	3
5	IS4003	Optimization Techniques	PEC	3	0	0	3	3

SEMESTER II, ELECTIVE II & III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	IS4004	Transport Safety	PEC	3	0	0	3	3
2	IS4005	Fireworks Safety	PEC	3	0	0	3	3
3	IS4006	Safety in Construction	PEC	3	0	0	3	3
4	IS4007	Nuclear Engineering and Safety	PEC	3	0	0	3	3
5	IS4008	Safety in Textile Industry	PEC	3	0	0	3	3
6	IS4009	Safety in Mines	PEC	3	0	0	3	3
7	IS4010	Dock Safety	PEC	3	0	0	3	3

SEMESTER III, ELECTIVE IV & V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	IS4011	Safety in Engineering Industry	PEC	3	0	0	3	3
2	IS4012	Quality Engineering in Production Systems	PEC	3	0	0	3	3
4	IS4013	ISO 45001 and ISO 14000	PEC	3	0	0	3	3
5	IS4014	Artificial Intelligence and Expert Systems	PEC	3	0	0	3	3
6	IL4091	Design of Experiments	PEC	3	0	0	3	3
7	IS4071	Data Analytics	PEC	3	0	0	3	3

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SL. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	AX4091	English for Research Paper Writing	2	0	0	0
2.	AX4092	Disaster Management	2	0	0	0
3.	AX4093	Constitution of India	2	0	0	0
4.	AX4094	நற்றமிழ் இலக்கியம்	2	0	0	0

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	IS4212	Technical Seminar - I	0	0	2	1	2
2.	IS4311	Project Work I	0	0	12	6	3
3.	IS4312	Industrial Safety Assessment – Internship	0	0	4	2	3
4.	IS4411	Project Work II	0	0	24	12	4
TOTAL CREDITS						21	

LIST OF OPEN ELECTIVES FOR PG PROGRAMMES

SL. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	OCE431	Integrated Water Resources Management	3	0	0	3
2.	OCE432	Water, Sanitation and Health	3	0	0	3
3.	OCE433	Principles of Sustainable Development	3	0	0	3
4.	OCE434	Environmental Impact Assessment	3	0	0	3
5.	OIC431	Blockchain Technologies	3	0	0	3
6.	OIC432	Deep Learning	3	0	0	3
7.	OBA431	Sustainable Management	3	0	0	3
8.	OBA432	Micro and Small Business Management	3	0	0	3
9.	OBA433	Intellectual Property Rights	3	0	0	3
10.	OBA434	Ethical Management	3	0	0	3
11.	ET4251	IoT for Smart Systems	3	0	0	3
12.	ET4072	Machine Learning and Deep Learning	3	0	0	3
13.	PX4012	Renewable Energy Technology	3	0	0	3
14.	PS4093	Smart Grid	3	0	0	3
15.	CP4391	Security Practices	3	0	0	3
16.	MP4251	Cloud Computing Technologies	3	0	0	3
17.	IF4072	Design Thinking	3	0	0	3
18.	MU4153	Principles of Multimedia	3	0	0	3
19.	DS4015	Big Data Analytics	3	0	0	3
20.	NC4201	Internet of Things and Cloud	3	0	0	3
21.	MX4073	Medical Robotics	3	0	0	3
22.	VE4202	Embedded Automation	3	0	0	3
23.	CX4016	Environmental Sustainability	3	0	0	3
24.	TX4092	Textile Reinforced Composites	3	0	0	3
25.	NT4002	Nanocomposite Materials	3	0	0	3
26.	BY4016	IPR, Biosafety and Entrepreneurship	3	0	0	3

SUMMARY

Name of the Programme: M.E						
	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1.	FC	4	-	-	-	4
2.	PCC	12	14	3	-	28
3.	PEC	3	6	6	-	15
4.	RMC	2	-	-	-	2
5.	OEC	-	-	3	-	3
6.	EEC	-	1	8	12	21
7.	Non Credit/Audit Course					
8.	CC	2				2
9.	TOTAL CREDIT					75



REFERENCES:

1. Anderson, O.D, "Time Series Analysis: Theory and Practice", North - Holland, Amsterdam, 1982.
2. Devore, J. L., "Probability and Statistics for Engineering and Sciences", 9th Edition, Cengage Learning, 2016.
3. Gupta S.C. and Kapoor V.K.," Fundamentals of Mathematical Statistics", 12th Edition, Sultan and Sons, New Delhi, 2020.
4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers, 9th Edition, Pearson Education, Asia, 2016.
5. Montgomery D.C and Johnson, L.A, "Forecasting and Time Series", 6th Edition, McGraw Hill, 1990.

IS4101

PRINCIPLES OF SAFETY MANAGEMENT

L T P C
3 0 0 3

OBJECTIVES:

- To achieve an understanding of principles of safety management.
- To enable the students to learn about various functions and activities of safety department.
- To enable students to conduct safety audit and write audit reports effectively in auditing situations.
- To have knowledge about sources of information for safety promotion and training.
- To familiarize students with evaluation of safety performance.

UNIT I CONCEPTS AND TECHNIQUES 9

History of Safety movement –Evolution of modern safety concept- general concepts of management – planning for safety for optimization of productivity -productivity, quality and safety-line and staff functions for safety-budgeting for safety-safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.

UNIT II SAFETY AUDIT 9

Components of safety audit, types of audit, audit methodology, non-conformity reporting (NCR), audit checklist and report – review of inspection, remarks by government agencies, consultants, experts – perusal of accident and safety records, formats – implementation of audit indication - liaison with departments to ensure co-ordination – check list – identification of unsafe acts of workers and unsafe conditions in the shop floor.

UNIT III ACCIDENT INVESTIGATION AND REPORTING 9

Concept of an accident, reportable and non reportable accidents, reporting to statutory authorities – principles of accident prevention – accident investigation and analysis – records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – domino sequence – supervisory role – role of safety committee –cost of accident.

UNIT IV SAFETY PERFORMANCE MONITORING 9

ANSI (Z16.1) Recommended practices for compiling and measuring work injury experience – permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety "t" score, safety activity rate – problems.

UNIT V SAFETY EDUCATION AND TRAINING**9**

Importance of training-identification of training needs-training methods – programmes, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

TOTAL: 45 PERIODS**OUTCOMES:**

The students will be able to

- To understand the functions and activities of safety engineering department.
- To carry out a safety audit and prepare a report for the audit.
- To prepare an accident investigation report.
- To estimate the accident cost using supervisors report and data.
- To evaluate the safety performance of an organization from accident records.
- To identify various agencies, support institutions and government organizations involved in safety training and promotion

REFERENCES:

1. "Accident Prevention Manual for Industrial Operations", N.S.C.Chicago, 13th Edition 2009.
2. Blake R.B., "Industrial Safety" Prentice Hall, Inc., New Jersey, . 3rd Edition 2000.
3. Dan Petersen, "Techniques of Safety Management", McGraw-Hill Company, Tokyo, 1981.
4. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980
5. John Ridley, "Safety at Work", Butterworth and Co., London, 1983
6. Lees, F.P., "Loss Prevention in Process Industries" Butterworth publications, London, 2nd edition, 1990.
7. Relevant Indian Standards and Specifications, BIS, New Delhi.
8. "Safety and Good House Keeping", N.P.C., New Delhi, 1985.

CO-PO MAPPING:

CO	PO					
	1	2	3	4	5	6
1	3		2		-	-
2	-		3		-	-
3	-		-		-	-
4	-		-	2	-	-
5	-		-		-	-
AVG.	3/1=3	-	(3+2)/2=2.5	2	-	-

1-low, 2-medium, 3-high, '-'- no correlation

OBJECTIVES:

- To provide in depth knowledge in Principles of Environmental safety and its applications in various fields.
- To give understanding of air and water pollution and their control.
- To expose the students to the basis in hazardous waste management.
- To design emission measurement devices.

UNIT I AIR POLLUTION**9**

Classification and properties of air pollutants – Pollution sources – Effects of air pollutants on human beings, Animals, Plants and Materials - automobile pollution-hazards of air pollution-concept of clean coal combustion technology - ultra violet radiation, infrared radiation, radiation from sun-hazards due to depletion of ozone - deforestation-ozone holes-automobile exhausts-chemical factory stack emissions-CFC.

UNIT II WATER POLLUTION**9**

Classification of water pollutants-health hazards-sampling and analysis of water-water treatment - different industrial effluents and their treatment and disposal -advanced wastewater treatment - effluent quality standards and laws- chemical industries, tannery, textile effluents-common treatment.

UNIT III HAZARDOUS WASTE MANAGEMENT**9**

Hazardous waste management in India-waste identification, characterization and classification-technological options for collection, treatment and disposal of hazardous waste-selection charts for the treatment of different hazardous wastes-methods of collection and disposal of solid wastes-health hazards-toxic and radioactive wastes-incineration and verification - hazards due to bio-process-dilution-standards and restrictions – recycling and reuse.

UNIT IV ENVIRONMENTAL MEASUREMENT AND CONTROL**9**

Sampling and analysis – dust monitor – gas analyzer, particle size analyzer – lux meter-pH meter – gas chromatograph – atomic absorption spectrometer.
Gravitational settling chambers-cyclone separators-scrubbers-electrostatic precipitator - bag filter – maintenance - control of gaseous emission by adsorption, absorption and combustion methods-Pollution Control Board-laws.

UNIT V POLLUTION CONTROL IN PROCESS INDUSTRIES**9**

Pollution control in process industries - cement, paper, petroleum-petroleum products-textile-tanneries-thermal power plants – dying and pigment industries - eco-friendly energy.

TOTAL: 45 PERIODS**OUTCOMES:**

The students will be able to

- Illustrate and familiarize the basic concepts scope of environmental safety.
- Understand the standards of professional conduct that are published by professional safety organizations and/or certification bodies.
- Explain the ways in which environmental health problems have arisen due to air and water pollution.
- Illustrate the role of hazardous waste management and use of critical thinking to identify and assess environmental health risks.
- Discuss concepts of measurement of emissions and design emission measurement devices.

REFERENCES:

1. E. C Wolfe, Race to Save to Save Planet, Wadsworth Publishing Co., Belmont, CA 2006.
2. G. T Miller, Environmental Science: Working with the Earth, 11th Edition, Wadsworth Publishing Co., Belmont, CA, 2006
3. M.J Hammer,., and M.J Hammer,., Jr., Water and Wastewater Technology, Pearson Prentice Hall, 2006
4. Rao, CS, "Environmental pollution engineering:., Wiley Eastern Limited, New Delhi, 1st January 2018.
5. S. P. Mahajan, "Pollution control in process industries", Tata McGraw Hill Publishing Company, New Delhi, 2006.
6. Varma and Braner, "Air pollution equipment", Springer Publishers, Second Edition.

CO-PO MAPPING:

CO	PO					
	1	2	3	4	5	6
1	3		2		-	-
2	-		3		-	-
3	-		-		-	-
4	-		-		-	-
5	-		-		-	-
AVg.	3/1=3	-	(3+2)/2=2.5	-	-	-

1- low, 2-medium, 3-high, '-'- no correlation

IS4103

OCCUPATIONAL HEALTH AND INDUSTRIAL HYGIENE

L T P C
3 0 0 3**OBJECTIVES:**

- To understand the basic knowledge on anatomy of human organs and its basic functions.
- To enable the students to learn about various functions and activities of occupational health services.
- To enable students to compare the hazards with the permissible levels.
- To have knowledge about types of hazards arising out of physical, chemical and biological agents.

UNIT I PHYSICAL HAZARDS**9**

Noise, compensation aspects, noise exposure regulation, properties of sound, occupational damage, risk factors, sound measuring instruments, octave band analyzer, noise networks, noise surveys, noise control program, industrial audiometry, hearing conservation programs- vibration, types, effects, instruments, surveying procedure, permissible exposure limit.

Ionizing radiation, types, effects, monitoring instruments, control programs, OSHA standard- non-ionizing radiations, effects, types, radar hazards, microwaves and radio-waves, lasers, TLV- cold environments, hypothermia, wind chill index, control measures- hot environments, thermal comfort, heat stress indices, acclimatization, estimation and control

UNIT II CHEMICAL HAZARDS 9

Recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases, types, concentration, Exposure vs. dose, TLV - Methods of Evaluation, process or operation description, Field Survey, Sampling methodology, Industrial Hygiene calculations, Comparison with OSHAS Standard.

Air Sampling instruments, Types, Measurement Procedures, Instruments Procedures, Gas and Vapour monitors, dust sample collection devices, personal sampling

Methods of Control - Engineering Control, Design maintenance considerations, design specifications - General Control Methods - training and education

UNIT III BIOLOGICAL AND ERGONOMICAL HAZARDS 9

Classification of Biohazardous agents – examples, bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases – Covid SARS - Biohazard control program, employee health program-laboratory safety program-animal care and handling-biological safety cabinets - building design.

Work Related Musculoskeletal Disorders –carpal tunnel syndrome CTS- Tendon pain-disorders of the neck- back injuries.

UNIT IV OCCUPATIONAL HEALTH AND TOXICOLOGY 9

Concept and spectrum of health - functional units and activities of occupational health services, pre-employment and post-employment medical examinations - occupational related diseases, levels of prevention of diseases, notifiable occupational diseases such as silicosis, asbestosis, pneumoconiosis, siderosis, anthracosis, aluminosis and anthrax, lead-nickel, chromium and manganese toxicity, gas poisoning (such as CO, ammonia, coal and dust etc) their effects and prevention – cardio pulmonary resuscitation, audiometric tests, eye tests, vital function tests.

Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems.

UNIT V OCCUPATIONAL PHYSIOLOGY 9

Man as a system component – allocation of functions – efficiency – occupational work capacity – aerobic and anaerobic work – evaluation of physiological requirements of jobs – parameters of measurements – categorization of job heaviness – work organization – stress – strain – fatigue – rest pauses – shift work – personal hygiene.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able

- To understand the various physiological functions of our body and the test methods for periodical monitoring of health.
- To understand the functions and activities of Occupational health services.
- To identify various types of hazards arising out of physical, chemical and biological agents in a process.
- To identify notifiable occupational diseases arising out of Occupation and suggest methods for the prevention of such diseases.

REFERENCES:

1. Benjamin O.Alli, Fundamental Principles of Occupational Health and Safety ILO 2008.
2. Danuta Koradecka, Handbook of Occupational Health and Safety, CRC, 2010.
3. E.J. McCornick, and M. S Sanders, Human Factors in Engineering and Design, Tata McGraw-Hill, 1992.
4. Encyclopedia of "Occupational Health and Safety", Vol.I and II, published by International Labour Office, Geneva, 1985
5. Hand book of "Occupational Safety and Health", National Safety Council, Chicago, 2002.
6. Lawrence Slote , Handbook of occupational safety and health, Wiley, 2001.
7. Louis J. Di Berardinis, Handbook of occupational safety and health Wiley, 1999.
8. Interim guidance "COVID-19: Occupational health and safety for health workers", WHO & ILO,2021.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	3		2		-	-
2	-		3		-	-
3	-		-		-	-
4	-		-		-	-
5	-		-		-	-
AVg.	3/1=3	-	(3+2)/2=2.5	-	-	-

1 - low, 2-medium, 3-high, '-'- no correlation

IS4104

INDUSTRIAL SAFETY, HEALTH AND ENVIRONMENT ACTS

L T P C
3 0 0 3

OBJECTIVES:

- To provide exposure to the students about safety and health provisions related to hazardous processes as laid out in Factories act 1948.
- To familiarize students with powers of inspectorate of factories.
- To help students to learn about Environment act 1986 and rules framed under the act.
- To provide wide exposure to the students about various legislations applicable to an industrial unit.

UNIT I FACTORIES ACT – 1948

9

Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Tamilnadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948. Forms, Registers and notices – Tamilnadu Safety Officer Rules 2005- with updated Amendments.

UNIT II ENVIRONMENT ACT – 1986

9

General powers of the central government, prevention, control and abatement of environmental pollution-Biomedical waste (Management and handling Rules, 1989-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001- No Objection certificate from statutory authorities like pollution control board.

Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards – prevention and control of air pollution and water pollution – fund – accounts and audit, penalties and procedures.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	3		2		-	-
2	-		3		-	-
3	-		-		-	-
4	-		-		-	-
5	-		-		-	-
AVg.	3/1=3	-	(3+2)/2=2.5	-	-	-

1- low, 2-medium, 3-high, ‘-‘- no correlation

RM4151 RESEARCH METHODOLOGY AND IPR **L T P C**
2 0 0 2

UNIT I RESEARCH DESIGN **6**

Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES **6**

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING **6**

Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS **6**

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V PATENTS **6**

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL : 30 PERIODS

REFERENCES

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

OBJECTIVES:

- To Inculcate the Industrial Safety Environment to the students
- To Explore the Human Capital Management and Hazardous System

DESCRIPTION OF THE COURSE

- The students are expected to make a presentation on the state of Safety Audit from the observation from the Industry Safety Department.
- A faculty guide is to be allotted and the Student will visit the industry to aware about the Importance of the Safety.
- Students are encouraged to prepare the Safety System Guidelines from your observation period of Inspection from the Industry Safety Department and contribute the same to the Environment Contribution.
- The Students are advised to go through the below mentioned following heads of safety Measures to be audit and inspect at the time of visit. Depending on the requirements of the organizations, the audit can focus attention on the following aspects of a safety system and make sure that your level of expertise in the safety system.

Every safety audit as per 'The Code of Practice' on Occupational Safety & Health 'Indian Standard – 14489:2018, ISO 45001:2018, EMS- ISO 14001:2015, NBC:2016 and other national and international standard applicable to each particular industry.

- Safety Management systems.
- Fire and Explosion prevention, protection and emergency management.
- Work injury prevention.
- Health hazards control.
- Evaluating emergency plan.
- First aid practices
- Management of health and safety
- Accidents and accident reporting
- Asbestos
- Contractors
- Display screen equipment
- Electrical safety
- Emergency lighting
- Environmental protection
- Fire prevention and emergencies
- Hazardous substances
- Housekeeping and cleanliness
- Information and communication
- Kitchens, catering and food safety
- Lifts and lifting equipment
- Manual handling operations
- Noise
- Occupational health
- Personal protective equipment
- Plant rooms, machinery and equipment
- Risk assessment requirements
- Safety Policy
- Safety signs and notices

- Training
- Use of vehicles / vehicle safety
- Water services
- Welfare provision
- Working time
- Work at heights
- Workplace environment
- Accident prevention
- Identifying and correcting Regulatory Deficiencies
- Improvement of Employee Morale
- Identification and Elimination of Safety Hazards

TOTAL: 30 PERIODS

OUTCOMES

The students will be able to

1. To Minimize the Labor turnover by existence of Safety Measures of an Employee.
2. To Promote the Fatigue Study it will lead to good production.
3. To Implement the Human Resource Management Practices.
4. To impart the Health Consciousness to the Working Community.

CO-PO MAPPING:

CO	PO					
	1	2	3	4	5	6
1	-	3	-	-	-	-
2	-	2	2	-	-	-
3	-	-	-	3	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
AVg.	-	5/2=2.5	2/1=2	3/1=3	-	-

1 - low, 2-medium, 3-high, '-'- no correlation

IS4201

FIRE ENGINEERING AND EXPLOSION CONTROL

L T P C
3 0 0 3

OBJECTIVES:

- To provide an in depth knowledge about the science of fire.
- To understand the causes and effects of fire.
- To know the various fire prevention systems and protective equipments.
- To understand the science of explosion and its prevention techniques.
- To understand the various fire prevention techniques to be followed in a building.

UNIT I PHYSICS AND CHEMISTRY OF FIRE

9

Fire properties of solid, liquid and gases - fire spread - toxicity of products of combustion - theory of combustion and explosion – vapour clouds – flash fire – jet fires – pool fires – unconfined vapour cloud explosion, shock waves - auto-ignition – boiling liquid expanding vapour explosion – case studies – Flixborough, Mexico disaster, Pasedena Texas, Piper Alpha, Peterborough and Bombay Victoria dock ship explosions.

UNIT II FIRE PREVENTION AND PROTECTION 9

Sources of ignition – fire triangle – principles of fire extinguishing – active and passive fire protection systems – various classes of fires – A, B, C, D, E – types of fire extinguishers – fire stoppers – hydrant pipes – hoses – monitors – fire watchers – lay out of stand pipes – fire station-fire alarms and sirens – maintenance of fire trucks – foam generators – escape from fire rescue operations – fire drills – notice-first aid for burns.

UNIT III INDUSTRIAL FIRE PROTECTION SYSTEMS 9

Sprinkler-hydrants-stand pipes – special fire suppression systems like deluge and emulsifier, selection criteria of the above installations, reliability, maintenance, evaluation and standards – alarm and detection systems. Other suppression systems – CO₂ system, foam system, dry chemical powder (DCP) system, halon system – need for halon replacement – smoke venting. Portable extinguishers – flammable liquids – tank farms – indices of inflammability-fire fighting systems.

UNIT IV BUILDING FIRE SAFETY 9

Objectives of fire safe building design, Fire load, fire resistant material and fire testing – structural fire protection – structural integrity – concept of egress design - exists – width calculations - fire certificates – fire safety requirements for high rise buildings – snookers.

UNIT V EXPLOSION PROTECTING SYSTEMS 9

Principles of explosion-detonation and blast waves-explosion parameters – Explosion Protection, Containment, Flame Arrestors, isolation, suppression, venting, explosion relief of large enclosure-explosion venting-inert gases, plant for generation of inert gas-rupture disc in process vessels and lines explosion, suppression system based on carbon dioxide (CO₂) and halons-hazards in LPG, ammonia (NH₃), sulphur dioxide (SO₃), chlorine (CL₂) etc.

TOTAL: 45 PERIODS

OUTCOMES:

- To make familiar about basic concepts of fire and explosion science.
- To know the different source of ignition and their prevention techniques.
- To understand the operation of various types of firefighting equipments.
- To understand the causes and prevention of explosion.
- To equip the students to effectively employ explosion protection techniques and their significances to suit the industrial requirement.

REFERENCES

1. "Accident Prevention manual for industrial operations" N.S.C., Chicago, 1982.
2. "Davis Daniel et al, "Hand Book of fire technology"
3. "Fire Prevention and firefighting", Loss prevention Association, India.
4. Derek, James, "Fire Prevention Hand Book", Butter Worths and Company, London, 1986.
5. Dinko Tuhtar, "Fire and explosion protection"
6. Fire fighters hazardous materials reference book "Fire Prevention in Factories", an Nostrand Rein Hold, New York, 1991.
7. Gupta, R.S., "Hand Book of Fire Technology" Orient Longman, Bombay 1977.
8. Relevant Indian Acts and rules, Government of India.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	3	-	-	-	-
2	-	-	3	-	-	-
3	-	-	-	2	-	-
4	-	-	-	-	3	-
5	-	-	-	-	-	2
AVG.	-	3/1=3	3/1=3	2/1=2	3/1=3	2/1=2

1 - low, 2-medium, 3-high, ‘-‘- no correlation

IS4202

SYSTEM SIMULATION AND HAZARD ANALYSIS

L T P C

4 0 0 4

OBJECTIVES:

- To provide knowledge on risk, hazard and their assessment techniques in Industry
- To understand the principles of operation of various equipment for safety application
- To know the consequences of fire, explosion and toxic release
- To know the various software available for risk quantification
- To conduct a risk assessment technique in Industries.

UNIT I HAZARD, RISK ISSUES AND HAZARD ASSESSMENT

12

Introduction, hazard, hazard monitoring-risk issue, group or societal risk, individual risk, voluntary and involuntary risk, social benefits Vs technological risk, approaches for establishing risk acceptance levels, Risk estimation. Hazard assessment, procedure, methodology; safety audit, checklist analysis, what-if analysis, safety review, preliminary hazard analysis(PHA), human error analysis, hazard operability studies(HAZOP), safety warning systems.

UNIT II COMPUTER AIDED INSTRUMENTS

12

Applications of Advanced Equipments and Instruments, Thermo Calorimetry, Differential Scanning Calorimeter(DSC), Thermo Gravimetric Analyser(TGA), Accelerated Rate Calorimeter(ARC), Reactive Calorimeter(RC), Reaction System Screening Tool(RSST) - Principles of operations, Controlling parameters, Applications, advantages.

Explosive Testing, Deflagration Test, Detonation Test, Ignition Test, Minimum ignition energy Test, Sensitiveness Test, Impact Sensitiveness Test(BAM) and Friction Sensitiveness Test (BAM), Shock Sensitiveness Test, Card Gap Test.

UNIT III RISK ANALYSIS QUANTIFICATION AND SOFTWARES

12

Introduction to Discrete and Continuous Systems Simulation- Fault Tree Analysis and Event Tree Analysis, Logic symbols, methodology, minimal cut set ranking - fire explosion and toxicity index(FETI), various indices - Hazard analysis(HAZAN)- Failure Mode and Effect Analysis(FMEA)- Basic concepts of Reliability- Software on Risk analysis, CISCON, FETI, HANGARS modules on Heat radiation, Pool fire, Jet, Explosion. Reliability softwares on FMEA for mechanical and electrical systems.

UNIT IV CONSEQUENCES ANALYSIS**12**

Logics of consequences analysis- Estimation- Hazard identification based on the properties of chemicals- Chemical inventory analysis- identification of hazardous processes- Estimation of source term, Gas or vapour release, liquid release, two phase release- Heat radiation effects, BLEVE, Pool fires and Jet fire- Gas/vapour dispersion- Explosion, UVCE and Flash fire, Explosion effects and confined explosion- Toxic effects- Plotting the damage distances on plot plant/layout.

UNIT V CREDIBILITY OF RISK ASSESSMENT TECHNIQUES**12**

Past accident analysis as information sources for Hazard analysis and consequences analysis of chemical accident, Mexico disaster, Flixborough, Bhopal, Seveso, Pasadena, Feyzin disaster(1966), Port Hudson disaster- convey report, hazard assessment of non-nuclear installation- Rijnmond report, risk analysis of size potentially Hazardous Industrial objects- Rasmussen masses report, Reactor safety study of Nuclear power plant

TOTAL: 60 PERIODS**OUTCOMES:**

- This course would make familiarizing of basic concepts in risk and hazard
- Course would be helpful to understand the various instruments to bring safety in Industries
- Students would be trained to find solution for risk assessment studies through the use of software
- Students would be able to make use of a risk assessment technique to quantify the risk
- Course would equip the students effectively to employ hazard analysis techniques in Industry and helpful to prevent the accidents in Industry

REFERENCES

1. Brown, D.B. System analysis and Design for safety, Prentice Hall, 1976.
2. Course Material Intensive Training Programme on Consequence Analysis, by Process Safety Centre, Indian Institute of Chemical Technology, Tarnaka and CLRI, Chennai.
3. Guidelines for Hazard Evaluation Procedures, Centre for Chemical Process safety, AIChE 1992
4. Hazop and Hazom, by Trevor A Klett, Institute of Chemical Engineering.
5. ILO- Major Hazard control- A practical Manual, ILO, Geneva, 1988.
6. Loss Prevention in Process Industries-Frank P. Less Butterworth-Hein UK 1990 (Vol.I, II and III)
7. Methodologies for Risk and Safety Assessment in Chemical Process Industries, Common wealth Science Council, UK
8. Quantitative Risk assessment in Chemical Industries, Institute of Chemical Industries, Centre for Chemical process safety.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	3	-	-	-	2
2	-	-	-	-	-	3
3	-	-	-	2	-	-
4	-	-	-	-	3	-
5	-	-	2	-	-	-
AVg.	-	3/1=3	2/1=2	2/1=2	3/1=3	(2+3)/2=2.5

1 - low, 2-medium, 3-high, '-'- no correlation

OBJECTIVES:

- To provide knowledge on basics of electrical fire and statutory requirements for electrical safety
- To understand the causes of accidents due to electrical hazards
- To know the various protection systems in Industries from electrical hazards
- To know the importance of earthing
- To distinguish the various hazardous zones and applicable fire proof electrical devices

UNIT I CONCEPTS AND STATUTORY REQUIREMENTS 9

Introduction – electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical equipment-Indian electricity act and rules-statutory requirements from electrical inspectorate-international standards on electrical safety – first aid-cardio pulmonary resuscitation(CPR).

UNIT II ELECTRICAL HAZARDS 9

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy-current surges-Safety in handling of war equipments-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity –definition, sources, hazardous conditions, control, electrical causes of fire and explosion-ionization, spark and arc-ignition energy-national electrical safety code ANSI.

Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth pit maintenance.

UNIT III PROTECTION SYSTEMS 9

Fuse, circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage – voltage –safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no load protection-earth fault protection.

FRLS insulation-insulation and continuity test-system grounding-equipment grounding-earth leakage circuit breaker (ELCB)-cable wires-maintenance of ground-ground fault circuit interrupter-use of low voltage-electrical guards-Personal protective equipment – safety in handling hand held electrical appliances tools and medical equipments.

UNIT IV SELECTION, INSTALLATION, OPERATION AND MAINTENANCE 9

Role of environment in selection-safety aspects in application - protection and interlock-self diagnostic features and fail safe concepts-lock out and work permit system-discharge rod and earthing devices-safety in the use of portable tools-cabling and cable joints-preventive maintenance.

UNIT V HAZARDOUS ZONES 9

Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe equipment-their selection for different zones-temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies.

TOTAL: 45 PERIODS**OUTCOMES:**

- This course would make familiar of basic concepts in electrical circuit and hazards involved in it.
- Course would be helpful to understand the electrical hazards in Industries.
- Students would be able to understand the operation of various protection systems from electrical hazards
- Recognize different hazardous zones in Industries

REFERENCES

1. "Accident prevention manual for industrial operations", N.S.C., Chicago, 1982.
2. Indian Electricity Act and Rules, Government of India.
3. Power Engineers – Handbook of TNEB, Chennai, 1989.
4. Martin Glov Electrostatic Hazards in powder handling, Research Studies Pvt. Ltd., England, 1988.
5. Fordham Cooper, W., "Electrical Safety Engineering" Butterworth and Company, London, 1986.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	3	-	-	-	2
2	-	-	2	-	-	-
3	-	-	-	2	-	3
4	-	-	-	-	3	-
5	-	-	-	-	-	-
AVg.	-	3/1=3	2/1=2	2/1=2	3/1=3	(2+3)/2=2.5

1 - low, 2-medium, 3-high, '-'- no correlation

IS4204

SAFETY IN PROCESS INDUSTRIES

L T P C
3 0 0 3

OBJECTIVES:

- To provide knowledge on design features for a process industry and safety in the operation of various equipment in industry.
- To understand the various hazards and prevention in commissioning stage of industry.
- To recognise and identify the safe operation of equipment in process industry.
- To plan and trained for emergency planning in a process industry.
- To get fundamental knowledge on safe storage of chemicals.

UNIT I SAFETY IN PROCESS DESIGN AND PRESSURE SYSTEM DESIGN 9

Design process, conceptual design and detail design, assessment, inherently safer design- chemical reactor , types, batch reactors, reaction hazard evaluation, assessment, reactor safety, operating conditions, unit operations and equipments, utilities.

Pressure system, pressure vessel design, standards and codes- pipe works and valves- heat exchangers- process machinery- over pressure protection, pressure relief devices and design, fire relief, vacuum and thermal relief, special situations, disposal- flare and vent systems- failures in pressure system.

UNIT II PLANT COMMISSIONING AND INSPECTION 9

Commissioning phases and organization, pre-commissioning documents, process commissioning, commissioning problems, post commissioning documentation

Plant inspection, pressure vessel, pressure piping system, non destructive testing, pressure testing, leak testing and monitoring- plant monitoring, performance monitoring, condition, vibration, corrosion, acoustic emission-pipe line inspection.

UNIT III PLANT OPERATIONS**9**

Operating discipline, operating procedure and inspection, format, emergency procedures- hand over and permit system- start up and shut down operation, refinery units- operation of fired heaters, driers, storage- operating activities and hazards- trip systems- exposure of personnel

UNIT IV PLANT MAINTENANCE, MODIFICATION AND EMERGENCY PLANNING**9**

Management of maintenance, hazards- preparation for maintenance, isolation, purging, cleaning, confined spaces, permit system- maintenance equipment- hot works- tank cleaning, repair and demolition- online repairs- maintenance of protective devices- modification of plant, problems- controls of modifications.

Emergency planning, disaster planning, onsite emergency- offsite emergency, APELL

UNIT V STORAGES**9**

General consideration, petroleum product storages, storage tanks and vessel- storages layout- segregation, separating distance, secondary containment- venting and relief, atmospheric vent, pressure, vacuum valves, flame arrestors, fire relief- fire prevention and protection- LPG storages, pressure storages, layout, instrumentation, vapourizer, refrigerated storages- LNG storages, hydrogen storages, toxic storages, chlorine storages, ammonia storages, other chemical storages- underground storages- loading and unloading facilities- drum and cylinder storage- ware house, storage hazard assessment of LPG and LNG

TOTAL: 45 PERIODS**OUTCOMES:**

- This course would make familiar of safe design of equipment which are the essential to chemical industry and leads to design of entire process industries.
- Course would be helpful to understand the design of pressure systems.
- Students would understand the problems and find innovative solutions while industries facing Problems in commissioning and maintenance stages.
- Students can prepare the emergency planning for chemical industry problems
- Students would be able to create safe storage systems.

REFERENCES

1. "Accident Prevention Manual for Industrial Operations" NSC, Chicago, 1982.
2. "Quantitative Risk Assessment in Chemical Process Industries" American Institute of Chemical Industries, Centre for Chemical Process safety.
3. Carbide of Calcium Rules, Government of India.
4. Fawcett, H.h. and Wood, "Safety and Accident Prevention in Chemical Operations" Wiley inters, Second Edition.
5. GREEN, A.E., "High Risk Safety Technology", John Wiley and Sons,. 1984.
6. Lees, F.P. "Loss Prevention in Process Industries" Butterworths and Company, 1996
7. Petroleum Act and Rules, Government of India.

CO-PO MAPPING:

CO	PO					
	1	2	3	4	5	6
1	-	-	-	-	3	-
2	-	-	2	-	-	-
3	-	-	-	2	-	-
4	-	3	-	-	1	-
5	-	-	-	-	-	2
AVg.	-	3/1=3	2/1=2	2/1=2	3/1=3	2/1=2

1 - low, 2-medium, 3-high, '-'- no correlation

OBJECTIVES:

- To provide opportunity to operate the equipment to acquire practical knowledge.
- To know the various PPEs and software.
- To carry out experiments to find out the environmental parameters.
- To assess the impact of sensitivity of chemicals on explosivity.
- To run the software to assess the consequence effects of major accidents.

FIRST AID CONCEPTS

Study of Emergency Kits ,First – aid, road safety signs and signals -Safety Software Demo

NOISE LEVEL MEASUREMENT AND ANALYSIS

Measurement of sound pressure level in dB for Impact, continuous and intermittent sources at various networks, peak and average values.

FRICTION TEST

Explosive materials like barium nitrate, gun powder, white powder, amorces composition etc.

IMPACT TEST

Explosive materials like gun powder, white powder, amerce composition etc.
Burst strength test of packaging materials like paper bags, corrugated cartoons, wood etc.
Auto ignition temperature test.

EXHAUST GAS MEASUREMENT AND ANALYSIS

Measurement of Sox, Nox, Cox, hydrocarbons.

ENVIRONMENTAL PARAMETER MEASUREMENT

Dry Bulb Temperature, Wet Bulb Temperature, Determination of relative humidity, wind flow and effective corrective effective.
Particle size Measurement
Air sampling analysis

TRAINING IN USAGE AND SKILL DEVELOPMENT**Personal protective equipment:**

Respiratory and non-respiratory-demonstration-self contained breathing apparatus. Safety helmet, belt, hand gloves, goggles, safety shoe, gum boots, ankle shoes, face shield, nose mask, ear plug, ear muff, anti static and conducting plastics/rubber materials, apron and leg guard.

Fire extinguishers and its operations

Water Co₂
Foam
Carbon dioxide (Co₂)
Dry chemical powder and
Currently amendment fire safety systems

Static charge testing on plastic, rubber, ferrous and non-ferrous materials.

Illumination testing - by lux meter and photo meter.

Electrical safety

Insulation resistance for motors and cables
Estimation of earth resistance
Earth continuity test
Sensitivity test for MCB, ELCB, RCCB, MCCB

Software Usage

Dispersion modeling of various highly dangerous chemicals using ALOHA software
SOFTWARE USAGE - Accident Analysis ,Safety Audit Packages, Consequence Analysis (CISCON),
Fire, Explosion and Toxicity Index (FETI), Reliability Analysis for Mechanical system and Electrical
System, Failure Mode Analysis

Experiments on simulation to be added

Discrete and continuous

Equipments Required

1.	Noise level meter	:	1 No
2.	Friction tester	:	1 No
3.	Impact tester	:	1 No
4.	Exhaust gas analyzer:		1 No
5.	High volume sampler	:	1 No
6.	PPE Set	:	1 No
7.	Fire extinguisher set	:	1 No
8.	Static charge tester	:	1 No
9.	First aid kit	:	1 No
10.	Lock out/Tag out	:	1 No
11.	Software: ALOHA, CAMEO		
12.	Extend SIM		
13.	System	:	12 No.

TOTAL: 30 PERIODS

OUTCOMES:

- This course would make students to know and run the various equipments to bring out the safety environment in the industry.
- Course would be helpful for the students to measure the particulate matter and assess the impact of air pollution.
- Students would be trained to conduct experiments to find out various environmental parameters. Students would be able to use personal protective equipment in-dependently.
- Students can recognise the various problems with the use of software and hence to predict the real situations on major accidents.

CO-PO MAPPING:

CO	PO					
	1	2	3	4	5	6
1	-	2	-	-	-	-
2	-	-	3	-	-	-
3	-	-	-	3	-	-
4	-	-	-	-	3	-
5	-	-	-	-	-	2
AVg.	-	2/1=2	3/1=3	3/1=3	3/1=3	2/1=2

1 - low, 2-medium, 3-high, '-'- no correlation

OBJECTIVES:

To enrich the communication skills of the student through presentation of topics in recent advances in Industrial safety engineering/technology

OUTCOME:

Students will develop skills to read, write, comprehend and present research papers.

Students shall give presentations on recent areas of research in industrial safety engineering in two cycles. Depth of understanding, coverage, quality of presentation material (PPT/OHP) and communication skill of the student will be taken as measures for evaluation.

TOTAL: 30 PERIODS**CO-PO MAPPING:**

CO	PO					
	1	2	3	4	5	6
1	3	-	3	-	2	-
2	-	-	-	-	-	3
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
AVg.	3/1=3	-	-	3/1=3	2/1=2	3/1=3

1 - low, 2-medium, 3-high, ‘-‘- no correlation

OBJECTIVES:

- Impart knowledge in reliability concepts.
- Facilitate students in filling the life data into theoretical distribution.
- Educate the students in reliability evaluation of various configuration.
- Impart knowledge in reliability monitoring methods.
- Analyze effectively various techniques to improve reliability of the system.

UNIT I RELIABILITY CONCEPTS**9**

Reliability definition – Quality and Reliability– Reliability mathematics – Reliability functions – Hazard rate – Measures of Reliability – Design life –A priori and posteriori probabilities – Mortality of a component –Mortality curve – Useful life.

UNIT II LIFE DATA ANALYSIS**9**

Data collection –Non Parametric methods: Ungrouped/Grouped, Complete/Censored data – Time to failure distributions: Exponential, Weibull – Probability plotting – Goodness of fit tests.

UNIT III RELIABILITY ASSESSMENT**9**

Different configurations – Redundancy – k out of n system – Complex systems: RBD – Baye’s approach – Cut and tie sets – Fault Trees – Standby systems.

UNIT IV RELIABILITY MONITORING

9

Life testing methods: Failure terminated – Time terminated – Sequential Testing –Reliability growth monitoring – Reliability allocation – Software reliability-Human reliability.

UNIT V RELIABILITY IMPROVEMENT

9

Analysis of downtime – Repair time distribution – System repair time – Maintainability prediction – Measures of maintainability – Inspection decisions –System Availability.

TOTAL: 45 PERIODS

OUTCOMES:

- CO1** : Understand the basic concepts of reliability engineering
- CO2** : Effectively analyze various non parametric methods and failure distributions
- CO3** : Conduct reliability assessment and failure analysis on any complex systems
- CO4** : Effectively design and analyze reliability monitoring techniques
- CO5** : Analyze various techniques to improve reliability of the system

	PO1	PO2	PO3	PO4	PO5	PO6
CO1		3				
CO2				3		
CO3	3					
CO4						
CO5						2
AVg.	3/1=3	3/1=3		3/1=3	-	2/1=2

REFERENCES:

1. Charles E. Ebeling, "An introduction to Reliability and Maintainability engineering", TMH, 2000.
2. Roy Billington and Ronald N. Allan, "Reliability Evaluation of Engineering Systems", Springer, 2007.

IS4312

INDUSTRIAL SAFETY ASSESSMENT – INTERNSHIP

L T P C
0 0 4 2

OBJECTIVES:

- To get an industrial exposure through various industrial environmental experiences and learning safety measures.
- To enhance the collective skills between theoretical knowledge and real-time safety implementations.

GUIDELINES:

- The students are expected to undergo meaningful, practical and hands-on-work experiences related to safety measures through industrial training.
- A faculty guide is to be allotted and he / she will guide and monitor the progress of the Student's training activities and maintain attendance also.
- Minimum duration of internships period is 3-4 weeks.
- Post internship program, Students should submit a report (within 50 pages) which contains brief observations of training (process, product, layout, safety measures and methods, etc..) and give a presentation.

- Internship should be evaluated through final presentation with viva-voce exam.

TOTAL: 60 PERIODS

OUTCOMES:

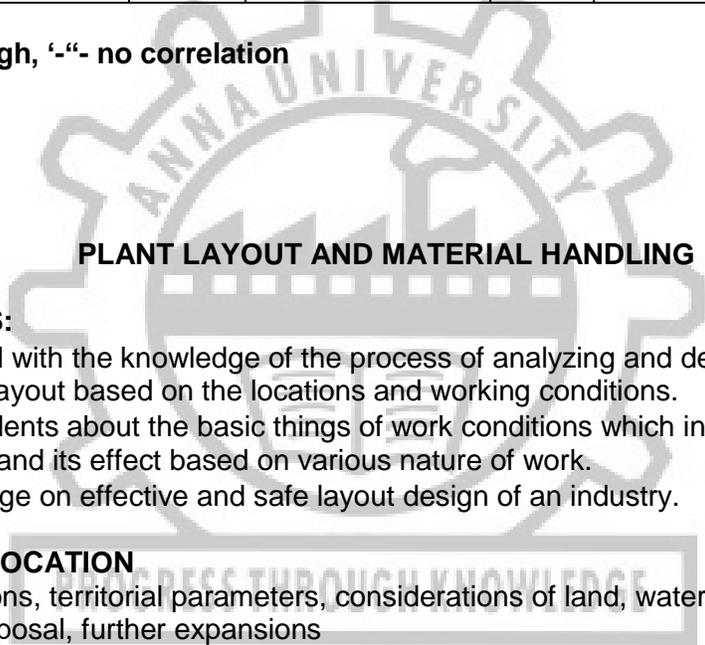
The students will be able to

1. Select and analysis the effective industry safety methods for the given field applications.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	2	3	-	3	2
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
AVg.	-	2/1=2	3/1=3	-	3/1=3	2/1=2

1 - low, 2-medium, 3-high, ‘-‘- no correlation



IL4076

PLANT LAYOUT AND MATERIAL HANDLING

**L T P C
3 0 0 3**

COURSE OBJECTIVES:

- To provide provided with the knowledge of the process of analyzing and developing information to produce a plant layout based on the locations and working conditions.
- To educate the students about the basic things of work conditions which includes ventilation, comfort, lighting and its effect based on various nature of work.
- To provide knowledge on effective and safe layout design of an industry.

UNIT I PLANT LOCATION

9

Selection of plant locations, territorial parameters, considerations of land, water, electricity, location for waste treatment and disposal, further expansions

Safe location of chemical storages, LPG, LNG, CNG, acetylene, ammonia, chlorine, explosives and propellants

UNIT II PLANT LAYOUT

9

Safe layout, equipment layout, safety system, fire hydrant locations, fire service rooms, facilities for safe effluent disposal and treatment tanks, site considerations, approach roads, plant railway lines, security towers.

Safe layout for process industries, engineering industry, construction sites, pharmaceuticals, pesticides, fertilizers, refineries, food processing, nuclear power stations, thermal power stations, metal powders manufacturing, fireworks and match works

UNIT III WORKING CONDITIONS

9

Principles of good ventilation, purpose, physiological and comfort level types, local and exhaust ventilation, hood and duct design, air conditioning, ventilation standards, application.

Purpose of lighting, types, advantages of good illumination, glare and its effect, lighting requirements for various work, standards- Housekeeping, principles of 5S.

UNIT IV MANUAL MATERIAL HANDLING AND LIFTING TACKLES

9

Preventing common injuries, lifting by hand, team lifting and carrying, handling specific shape machines and other heavy objects – accessories for manual handling, hand tools, jacks, hand trucks, dollies and wheel barrows – storage of specific materials - problems with hazardous materials, liquids, solids – storage and handling of cryogenic liquids - shipping and receiving, stock picking, dock boards, machine and tools, steel strapping and sacking, glass and nails, pitch and glue, boxes and cartons and car loading – personal protection – ergonomic considerations.

Fiber rope, types, strength and working load inspection, rope in use, rope in storage - wire rope, construction, design factors, deterioration causes, sheaves and drums, lubrication, overloading, rope fitting, inspection and replacement – slings, types, method of attachment, rated capacities, alloy chain slings, hooks and attachment, inspection

UNIT V MECHANICAL MATERIAL HANDLING

9

Hoisting apparatus, types - cranes, types, design and construction, guards and limit devices, signals, operating rules, maintenance safety rules, inspection and inspection checklist – conveyors, precautions, types, applications.

Powered industrial trucks, requirements, operating principles, operators selection and training and performance test, inspection and maintenance, electric trucks, gasoline operated trucks, LPG trucks – power elevators, types of drives, hoist way and machine room emergency procedure, requirements for the handicapped, types- Escalator, safety devices and brakes, moving walks – man lifts, construction, brakes, inspection.

TOTAL: 45 PERIODS

OUTCOMES:

- CO 1: The students will be able to Identify equipment requirements for a specific process and for various locations and working conditions.
- CO 2: The students will be able to Design an efficient material handling system.
- CO 3: Understand the difficulties during the design and implementation of the plant layout.
- CO 4: Know about material handling requirements and methods
- CO 5: Understand the inspection and maintenance techniques.

REFERENCES:

1. "Accident prevention manual for industrial operations" N.S.C., Chicago, 1982.
2. Alexandrov. M.P. "Material handling equipment" Mir Publishers, Moscow, 1981
3. APPLE M. JAMES "Plant layout and material handling", 3rd edition, John Wiley and sons.
4. "Encyclopedia of occupational safety and health", ILO Publication, 1985

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	-	-	-	-
CO2	-	-	-	-	-	-
CO3	2	-	-	2	-	-
CO4	-	-	-	-	2	-
CO5	-	-	-	-	2	-
Avg.	$(2+2)/2=2$	-	-	$2/1=2$	$(2+2)/2=2$	-

1 - low, 2-medium, 3-high, ‘-‘- no correlation

IS4001

WORK STUDY AND ERGONOMICS

L T P C
3 0 0 3

OBJECTIVES:

- To study the applications of ergonomic principles and physiology of workers
- To know the concepts of personal protective equipment and its usages
- To create the knowledge in process and equipment design in safety aspects

UNIT I WORK STUDY

9

Study of operations – work content – work procedure – breakdown – human factors – safety and method study – methods and movements at the workplace – substitution with latest devices – robotic concepts – applications in hazardous workplaces – productivity, quality and safety (PQS).

UNIT II ERGONOMICS

9

Definition – applications of ergonomic principles in the shop floor – work benches – seating arrangements – layout of electrical panels- switch gears – principles of motion economy – location of controls – display locations – machine foundations – work platforms, fatigue, physical and mental strain – incidents of accident – physiology of workers.

UNIT III PERSONAL PROTECTION

9

Concepts of personal protective equipment – types – selection of PPE – invisible protective barriers – procurement, storage, inspection and testing – quality – standards – ergonomic considerations in personal protective equipment design.

UNIT IV PROCESS AND EQUIPMENT DESIGN

9

Process design – equipment – instrument – selection – concept modules – various machine tools - in-built safety – machine layout-machine guarding-safety devices and methods – selection, inspection, maintenance and safe usage – statutory provisions, operator training and supervision – hazards and prevention.

UNIT V MAN MACHINE SYSTEMS

9

Job and personal risk factors – standards-selection and training-body size and posture-body dimension (static/dynamic) – adjustment range – penalties – guide lines for safe design and postures – evaluation and methods of reducing posture strain.

Man-machine interface-controls -types of control-identification and selection-types of displays-compatibility and stereotypes of important operations-fatigue and vigilance-measurement characteristics and strategies for enhanced performance.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able

1. To know in work procedure and applications in hazardous
2. Incorporate human factors in design of Personal protective equipment
3. Know the risk factors, guide lines for safe design of man machine systems considering human factors

REFERENCES

1. "Accident Prevention Manual for Industrial Operations", NSC Chicago, 1982.
2. "Work Study", National Productivity Council, New Delhi, 1995.
3. E.J.Mc Cormick and M.S.Sanders "Human Factors in Engineering and Design", TMH, New Delhi, 1982.
4. Hunter, Gomas, "Engineering Design for Safety", Mc Graw Hill Inc., 1992.
5. Introduction to Work Study", ILO, Oxford and IBH Publishing company, Bombay, 1991".
6. Mundel, Motion and Time Study, 6th Edition, Allied Publishers, Madras, 1989.
7. W.Benjamin Neibal Motion and Time Study, 9th Edition 1993.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	2	-	-	-	2
2	2	-	-	-	-	-
3	-	-	-	3	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
AVg.	2/1=2	2/1=2	-	3/1=3	-	2/1=2

1 - low, 2-medium, 3-high, '-'- no correlation

IL4074

HUMAN FACTORS THROUGH KNOWLEDGE

L T P C
3 0 0 3

OBJECTIVES:

- Studying the work procedure and understanding the relationships between the workers and working environments.
- To study the applications of ergonomic principles and physiology of workers.
- To know the concepts of personal protective equipment and its usages.
- To create the knowledge in process and equipment design in safety aspects.

UNIT I ERGONOMICS AND ANATOMY

9

Introduction to ergonomics: The focus of ergonomics, ergonomics and its areas of application in the work system, a brief history of ergonomics, attempts to humanize work, modern ergonomics, future directions for ergonomics

Anatomy, Posture and Body Mechanics: Some basic body mechanics, anatomy of the spine and pelvis related to posture, posture stability and posture adaptation, low back pain, risk factors for musculoskeletal disorders in the workplace, behavioural aspects of posture, effectiveness and cost effectiveness, research directions

UNIT II HUMAN BEHAVIOR

9

Individual differences, Factors contributing to personality, Fitting the man to the job, Influence of difference on safety, Method of measuring characteristics, Accident Proneness. Motivation, Complexity of Motivation, Job satisfaction. Management theories of motivation, Job enrichment theory. Frustration and Conflicts, Reaction to frustration, Emotion and Frustration. Attitudes-Determination of attitudes, Changing attitudes Learning, Principles of Learning, Forgetting, Motivational requirements.

UNIT III ANTHROPOMETRY AND WORK DESIGN FOR STANDING AND SEATED WORKS

9

Designing for a population of users, percentile, sources of human variability, anthropometry and its uses in ergonomics, principals of applied anthropometry in ergonomics, application of anthropometry in design, design for everyone, anthropometry and personal space, effectiveness and cost effectiveness

Fundamental aspects of standing and sitting, an ergonomics approach to work station design, design for standing workers, design for seated workers, work surface design, visual display units, guidelines for design of static work, effectiveness and cost effectiveness, research directions

UNIT IV MAN - MACHINE SYSTEM AND REPETITIVE WORKS AND MANUAL HANDLING TASK

9

Applications of human factors engineering, man as a sensor, man as information processor, man as controller – Man vs Machine.

Ergonomics interventions in Repetitive works, handle design, key board design- measures for preventing in work related musculoskeletal disorders (WMSDs), reduction and controlling, training Anatomy and biomechanics of manual handling, prevention of manual handling injuries in the work place, design of manual handling tasks, carrying, postural stability

UNIT V HUMAN SKILL AND PERFORMANCE AND DISPLAY, CONTROLS AND VIRTUAL ENVIRONMENTS

9

A general information-processing model of the users, cognitive system, problem solving, effectiveness.

Principles for the design of visual displays- auditory displays- design of controls- combining displays and controls- virtual (synthetic) environments, research issues.

TOTAL: 45 PERIODS

OUTCOMES:

- Students can have the knowledge in work procedure and applications in hazardous workplaces.
- Students can design their own safety devices and equipment to reduce the accidents possibilities.
- Students will be able to incorporate human factors in design of Personal protective equipment.
- They know the risk factors, guide lines for safe design of man machine systems considering human factors.

REFERENCES

1. Ergonomic design for organizational effectiveness, Michael O'Neill 1st Edition 1998.
2. Human factors in engineering and design, MARK S.SANDERS 1992.
3. Introduction to Ergonomics, R.S. Bridger, Taylor and Francis 3rd Edition 2008.
4. The Ergonomics manual, Dan Mc Leod, Philip Jacobs and Nancy Larson

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	-	-	3	-	-
2	-	-	3	-	-	-
3	2	-	-	-	-	2
4	-	-	-	-	3	-
5	-	-	-	-	-	-
AVg.	2/1=2	-	3/1=3	3/1=3	3/1=3	2/1=2

1- low, 2-medium, 3-high, ‘-‘- no correlation

IS4002

MAINTAINABILITY ENGINEERING

L T P C

3 0 0 3

OBJECTIVES:

- To enable the students know about the basic concept of maintainability engineering.
- To impart knowledge on various maintenance models, maintenance policies and replacement model of various equipment.
- To provide knowledge on logistics for the effective utilization of existing resources and facilities availability of spares parts.

UNIT I MAINTENANCE CONCEPT 6

Maintenance definition – Need for maintenance – Maintenance objectives and challenges – Tero technology – Maintenance costs - Scope of maintenance department.

UNIT II MAINTENANCE MODELS 12

Proactive/Reactive maintenance – Imperfect maintenance – Maintenance policies – PM versus b/d maintenance – PM schedule and product characteristics – Inspection models-Optimizing profit/downtime – Replacement decisions.

UNIT III MAINTENANCE LOGISTICS 11

Human factors – Maintenance staffing: Learning curves – Simulation – Maintenance resource requirements: Optimal size of service facility – Optimal repair effort – Maintenance planning and scheduling – Spare parts planning.

UNIT IV MAINTENANCE QUALITY 8

Maintenance excellence – Five Zero concept –FMECA –Root cause analysis – System effectiveness – Design for maintainability – Reliability Centered Maintenance.

UNIT V TOTAL PRODUCTIVE MAINTENANCE 8

TPM features – Chronic and sporadic losses – Equipment defects – Six major losses – Overall Equipment Effectiveness – TPM pillars – Autonomous maintenance – TPM implementation

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

1. Understand the various terms and terminologies about the maintenance concept.
2. Understand the various maintenance modes and logistics meant for the execution of various services.
3. Apply their knowledge in areas where the down time, over replacement are existing and could lead to improve the productivity and quality.

REFERENCES

1. Andrew K.S.Jardine & Albert H.C.Tsang, "Maintenance, Replacement and Reliability", Taylor and Francis, 2006.
2. Bikas Badhury & S.K.Basu, "Tero Technology: Reliability Engineering and Maintenance Management", Asian Books, 2003.
3. Seichi Nakajima, "Total Productive Maintenance", Productivity Press, 1993.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	-	-	-	3	-
2	-	-	3	-	-	-
3	-	2	-	-	-	2
4	-	-	-	2	-	-
5	-	-	-	-	-	-
AVg.	-	2/1=2	3/1=3	2/1=2	3/1=3	2/1=2

1- low, 2-medium, 3-high, "-- no correlation

IS4003

OPTIMIZATION TECHNIQUES

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the non-linear problem.
- To know about multi-objective problem.
- To create awareness of Meta heuristic algorithms.

UNIT I INTRODUCTION

5

Classification of optimization problems, concepts of design vector, Design constraints, constrains surface, objective function surface and multi-level optimization, parametric linear programming

UNIT II DECISION ANALYSIS

10

Decision Trees, Utility theory, Game theory, Multi Objective Optimization, MCDM- Goal Programming, Analytic Hierarchy process, ANP

UNIT III NON-LINEAR OPTIMIZATION

15

Unconstrained one variable and multi variable optimization, KKT Conditions, Constrained optimization, Quadratic programming, Convex programming, Separable programming, Geometric programming, Non-Convex programming

UNIT IV NON-TRADITIONAL OPTIMIZATION -1

10

Classes P and NP, Polynomial time reductions, Introduction to NP- Hard problems, Overview of Genetic algorithms, Simulated Annealing, neural network based optimization.

UNIT V NON-TRADITIONAL OPTIMIZATION -2**5**

Particle Swarm optimization, Ant Colony Optimization, Optimization of Fuzzy Systems.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

- The students will gain familiarity with some of the well-known optimization techniques and their applicability in a real setting.
- The students will gain awareness on the usefulness and limitation of optimization.

REFERENCES

1. Christos H. Papadimitriou, Kenneth Steiglitz, Combinatorial Optimization, PHI 2006
2. Fredrick S.Hillier and G.J.Liberman, "Introduction to Operations Research", McGraw Hill Inc. 1995.
3. Kalymanoy Deb, "Optimization for Engineering Design",PHI,2003
4. Ravindran – Phillips –Solberg, "Operations Research – Principles and Practice", John Wiley India, 2006.
5. Singiresu S.Rao, "Engineering optimization – Theory and practices", John Wiley and Sons, 1996.

IS4004**TRANSPORT SAFETY****L T P C
3 0 0 3****OBJECTIVES:**

- To provide the students about the various activities/steps to be followed in safe handling the hazardous goods transportation from one location to another location.
- To educate the reasons for the road accident and the roles and responsibilities of a safe Driver and the training needs of the driver.
- To inculcate the culture of safe driving and fuel conservation along with knowing of basic traffic symbols followed throughout the highways.

UNIT I TRANSPORTATION OF HAZARDOUS GOODS**9**

Transport emergency card (TREM) – driver training-parking of tankers on the highways-speed of the vehicle – warning symbols – design of the tanker lorries -static electricity-responsibilities of driver – inspection and maintenance of vehicles-check list- loading and decanting procedures – communication.

UNIT II ROAD TRANSPORT**8**

Introduction – factors for improving safety on roads – causes of accidents due to drivers and pedestrians-design, selection, operation and maintenance of motor trucks-preventive maintenance-check lists-motor vehicles act – motor vehicle insurance and surveys.

UNIT III DRIVER AND SAFETY**9**

Driver safety programme – selection of drivers – driver training-tacho-graph-driving test-driver's responsibility-accident reporting and investigation procedures-fleet accident frequency-safe driving incentives-slogans in driver cabin-motor vehicle transport workers act- driver relaxation and rest pauses – speed and fuel conservation – emergency planning and Haz mat codes

UNIT IV ROAD SAFETY**10**

Road alignment and gradient-reconnaissance-ruling gradient-maximum rise per k.m.- factors influencing alignment like tractive resistance, tractive force, direct alignment, vertical curves-breaking characteristics of vehicle-skidding-restriction of speeds-significance of speeds- Pavement conditions – Sight distance – Safety at intersections – Traffic control lines and guide posts-guard rails and barriers – street lighting and illumination overloading-concentration of driver.

Plant railway: Clearance-track-warning methods-loading and unloading-moving cars-safety practices.

UNIT V SHOP FLOOR AND REPAIR SHOP SAFETY**9**

Transport precautions-safety on manual, mechanical handling equipment operations-safe driving-movement of cranes-conveyors etc., servicing and maintenance equipment-grease rack operation-wash rack operation-battery charging-gasoline handling-other safe practices-off the road motorized equipment.

TOTAL: 45 PERIODS**OUTCOMES:**

The students will be able to

1. Recognize various safety activities undertaken in transporting of hazardous goods
2. Understand the various symbols which are specific to the road safety and able to reduce the accidents occurred in the roads.
3. Apply for the safe transportation of hazardous goods, creating TREM card and safe loading and unloading procedure.

REFERENCES:

1. "Accident Prevention Manual for Industrial Operations", NSC, Chicago, 1982.
2. Babkov, V.F., "Road Conditions and Traffic Safety" MIR Publications, Moscow, 1986.
3. K.W.Ogden, "Safer Roads – A guide to Road Safety Engineering"
4. Kadiyali, "Traffic Engineering and Transport Planning" Khanna Publishers, New Delhi, 1983.
5. Motor Vehicles Act, 1988, Government of India.
6. Pasricha, "Road Safety guide for drivers of heavy vehicle" Nasha Publications, Mumbai, 1999.
7. Popkes, C.A. "Traffic Control and Road Accident Prevention" Chapman and Hall Limited, 1986.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	-	-	3	-	-
2	-	-	3	-	2	-
3	2	-	-	-	-	3
4	-	-	-	-	-	-
5	-	-	-	-	-	-
AVg.	2/1=2	-	3/1=3	3/1=3	2/1=2	3/1=3

1- low, 2-medium, 3-high, '-'- no correlation

IS4005**FIREWORKS SAFETY****L T P C
3 0 0 3****OBJECTIVES:**

- To study the properties of pyrotechnic chemicals
- To know about the hazards in the manufacture of various fireworks
- To understand the hazards in fireworks industries related processes
- To study the effects of static electricity
- To learn pyrotechnic material handling, transportation and user safety

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	3	-	-	-	-
2	-	-	-	3	-	2
3	-	-	2	-	-	-
4	-	-	-	3	2	-
5	-	-	2	-	-	3
AVg.	-	3/1=3	(2+2)/2=2	(3+3)/2=3	2/1=2	(3+2)/2=2.5

1- low, 2-medium, 3-high, ‘-‘- no correlation

IS4006

SAFETY IN CONSTRUCTION

**L T P C
3 0 0 3**

OBJECTIVES:

- To know causes of accidents related to construction activities and human factors associated with these accident
- To understand the construction regulations and quality assurance in construction
- To have the knowledge in hazards of construction and their prevention methods
- To know the working principles of various construction machinery
- To gain knowledge in health hazards and safety in demolition work

UNIT I ACCIDENTS CAUSES AND MANAGEMENT SYSTEMS 9

Problems impeding safety in construction industry- causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with these accident – construction regulations, contractual clauses – Pre contract activates, preconstruction meeting - design aids for safe construction – permits to work – quality assurance in construction - compensation – Recording of accidents and safety measures – Education and training

UNIT II HAZARDS OF CONSTRUCTION AND PREVENTION 9

Excavations, basement and wide excavation, trenches, shafts – scaffolding , types, causes of accidents, scaffold inspection checklist – false work – erection of structural frame work, dismantling – tunneling – blasting, pre blast and post blast inspection – confined spaces – working on contaminated sites – work over water - road works – power plant constructions – construction of high rise buildings.

UNIT III WORKING AT HEIGHTS 9

Fall protection in construction OSHA 3146 – OSHA requirement for working at heights, Safe access and egress – safe use of ladders- Scaffoldings , requirement for safe work platforms, stairways, gangways and ramps – fall prevention and fall protection , safety belts, safety nets, fall arrestors, controlled access zones, safety monitoring systems – working on fragile roofs, work permit systems, height pass – accident case studies.

UNIT IV CONSTRUCTION MACHINERY 9

Selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist - builder’s hoist, winches, chain pulley blocks – use of conveyors - concrete mixers, concrete vibrators – safety in earth moving equipment, excavators, dozers, loaders, dumpers, motor grader, concrete pumps, welding machines, use of portable electrical tools, drills, grinding tools, manual handling scaffolding, hoisting cranes – use of conveyors and mobile cranes – manual handling.

UNIT V SAFETY IN DEMOLITION WORK**9**

Safety in demolition work, manual, mechanical, using explosive - keys to safe demolition, pre survey inspection, method statement, site supervision, safe clearance zone, health hazards from demolition - Indian standard - trusses, girders and beams – first aid – fire hazards and preventing methods – interesting experiences at the construction site against the fire accidents.

TOTAL: 45 PERIODS**OUTCOMES:**

Upon completion of the course the students will be able

- To identify the problems impeding safety in construction industries.
- To identify types and causes of accidents, and designing aids for safe construction.
- To understand the hazards during construction of power plant, road works and high rise buildings.
- To understand the safety procedure for working at heights during construction.
- To have knowledge in selection, operation, inspection and testing of various construction machinery.
- To list out construction regulations and Indian standards for construction and demolition work.

REFERENCES

1. Handbook of OSHA Construction safety and health Charles D. Reese and James V. Edison
2. Hudson, R., "Construction hazard and Safety Hand book, Butter Worth's, 1985.
3. Jnathea D.Sime, "Safety in the Build Environment", London, 1988.
4. V.J.Davies and K.Thomasin "Construction Safety Hand Book" Thomas Telford Ltd., London, 1990.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	2	-	-	-	-	-
2	-	-	-	3	-	2
3	-	3	-	-	-	-
4	-	-	-	2	2	-
5	-	-	2	-	-	-
AVg.	2/1=2	3/1=3	2/1=2	(3+2)/2=2.5	2/1=2	2/1=2

1- low, 2-medium, 3-high, '-'- no correlation

IS4007**NUCLEAR ENGINEERING AND SAFETY**
L T P C
3 0 0 3
OBJECTIVES:

- To know about nuclear energy and fission fusion process.
- To gain knowledge in reactor types, design considerations and their operational problems.
- To know the current status of India in nuclear energy.

UNIT I INTRODUCTION**9**

Binding energy – fission process – radio activity – alpha, beta and gamma rays radioactive decay – decay schemes – effects of radiation – neutron interaction – cross section – reaction rate – neutron moderation – multiplication – scattering – collision – fast fission – resonance escape – thermal utilization – criticality.

UNIT II REACTOR CONTROL 9

Control requirements in design considerations – means of control – control and shut down rods – their operation and operational problems – control rod worth – control instrumentation and monitoring – online central data processing system.

UNIT III REACTOR TYPES 9

Boiling water reactors – radioactivity of steam system – direct cycle and dual cycle power plants-pressurized water reactors and pressurized heavy water reactors – fast breeder reactors and their role in power generation in the Indian context – conversion and breeding – doubling time – liquid metal coolants – nuclear power plants in India.

UNIT IV SAFETY OF NUCLEAR REACTORS 9

Safety design principles – engineered safety features – site related factors – safety related systems – heat transport systems – reactor control and protection system – fire protection system – quality assurance in plant components – operational safety – safety regulation process – public awareness and emergency preparedness. Accident Case studies- Three Mile island and Chernobyl accident.

UNIT V RADIATION CONTROL 9

Radiation shielding – radiation dose – dose measurements – units of exposure – exposure limits – barriers for control of radioactivity release – control of radiation exposure to plant personnel – health physics surveillance – waste management and disposal practices – environmental releases.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

1. Demonstrate nuclear fission and fusion process and their utilization.
2. Understand types of reactors and their Control requirements.
3. Explain the safety design principles and safety regulation process.

REFERENCES

1. "Loss prevention in the process Industries" Frank P.Lees Butterworth-Hein-UK, 1990.
2. Loffness, R.L., "Nuclear Power Plant" Van Nostrand Publications, 1979.
3. M.M.E.L.Wakil, "Nuclear Energy Conversion", International Text Book Co.
4. M.M.E.L.Wakil, "Nuclear Power Engineering", International Text Book Co.
5. R.L.Murray, "Introduction to Nuclear Engineering", Prentice Hall.
6. Sri Ram K, "Basic Nuclear Engineering" Wiley Eastern Ltd., New Delhi, 1990.
7. Sterman U.S."Thermal and Nuclear Power Stations", MIR Publications, Moscow, 1986.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	-	-	2	-	-
2	-	-	-	-	2	-
3	-	-	-	-	-	3
4	-	-	-	-	-	-
5	-	-	-	-	-	-
AVg.	-	-	-	2/1=2	2/1=2	3/1=3

1- low, 2-medium, 3-high, '-'- no correlation

OBJECTIVES:

- To provide the student about the basic knowledge about the textile industries and its products by using various machineries.
- To enforce the knowledge on textile processing and various processes in making the yarn from cotton or synthetic fibres.
- To understand the various hazards of processing textile fibres by using various activities.
- To inculcate the knowledge on health and welfare activities specific to the Textile industries as per the Factories Act.

UNIT I INTRODUCTION**9**

Introduction to process flow charts of i) short staple spinning, ii) long staple spinning, iii) viscose rayon and synthetic fibre, manufacturer, iv) spun and filament yarn to fabric manufacture, v) jute spinning and jute fabric manufacture-accident hazard, guarding of machinery and safety precautions in opening, carding, combing, drawing, flyer frames and ring frames, doubles, rotor spinning, winding, warping, softening/spinning specific to jute.

UNIT II TEXTILE HAZARDS I**9**

Accident hazards i) sizing processes- cooking vessels, transports of size, hazards due to steam ii) Loom shed – shuttle looms and shuttless looms iii) knitting machines iv) non-wovens.

UNIT III TEXTILE HAZARDS II**9**

Scouring, bleaching, dyeing, punting, mechanical finishing operations and effluents in textile processes.

UNIT IV HEALTH AND WELFARE**9**

Health hazards in textile industry related to dust, fly and noise generated-control measures-relevant occupational diseases, personal protective equipment-health and welfare measures specific to textile industry, Special precautions for specific hazardous work environments.

UNIT V SAFETY STATUS**9**

Relevant provision of factories act and rules and other statutes applicable to textile industry – effluent treatment and waste disposal in textile industry.

TOTAL: 45 PERIODS**OUTCOMES:**

- The student will be able to know about the overall picture about the textile industries and its operations.
- The student could understand the various concepts underlying in the processes involved in processing of fibres to yarn.
- The student will be able to find out various hazards in the textile industry and will be able to apply the control measures to mitigate the risk emanating from the hazard.
- The student could have the capability to handle the various health and welfare activities as per the Factories act and could implement statutory requirements.
- The student could create of his own arrangement in designing various methods meant for mitigating the risk and able to guide his subordinates in executing the work safely.

REFERENCES:

1. 100 Textile fires – analysis, findings and recommendations LPA
2. Groover and Henry DS, “Hand book of textile testing and quality control”
3. “Quality tolerances for water for textile industry”, BIS
4. Shenai, V.A. “A technology of textile processing”, Vol.I, Textile Fibres
5. Little, A.H., “Water supplies and the treatment and disposal of effluent”
6. “Safety in Textile Industry” Thane Belapur Industries Association, Mumbai.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	-	-	-	2	-
2	-	-	-	3	-	2
3	-	-	2	-	-	-
4	-	-	-	2	-	-
5	-	-	-	-	2	-
AVg.	-	-	2/1=2	(3+2)/2=2.5	(2+2)/2=2	2/1=2

1- low, 2-medium, 3-high, ‘-’- no correlation

IS4009

SAFETY IN MINES

L T P C
3 0 0 3

OBJECTIVES:

- To provide in depth knowledge on Safety of mine s of various types.
- To study, know and understand about the types of mines and various risk involved in the mining operations.
- To get exposed to various types of accidents happened in mines and how to manage during accidents.
- To analyse the nature of mining activities and developing a safety system to reduce the risk and also to implement the Emergency preparedness in the working environment of mines and to plan for the disaster management.

UNIT I OPENCAST MINES

9

Causes and prevention of accident from: Heavy machinery, belt and bucket conveyors, drilling, hand tools-pneumatic systems, pumping, water, dust, electrical systems, fire prevention. Garage safety – accident reporting system-working condition-safe transportation – handling of explosives.

UNIT II UNDERGROUND MINES

9

Fall of roof and sides-effect of gases-fire and explosions-water flooding-warning sensors-gas detectors-occupational hazards-working conditions-winding and transportation.

UNIT III TUNNELLING

9

Hazards from: ground collapse, inundation and collapse of tunnel face, falls from platforms and danger from falling bodies. Atmospheric pollution (gases and dusts) – trapping –transport-noise-electrical hazards-noise and vibration from: pneumatic tools and other machines – ventilation and lighting – personal protective equipment.

UNIT IV RISK ASSESSMENT**9**

Basic concepts of risk-reliability and hazard potential-elements of risk assessment – statistical methods – control charts-appraisal of advanced techniques-fault tree analysis-failure mode and effect analysis – quantitative structure-activity relationship analysis-fuzzy model for risk assessment.

UNIT V ACCIDENT ANALYSIS AND MANAGEMENT**9**

Accidents classification and analysis-fatal, serious, minor and reportable accidents – safety audits-recent development of safety engineering approaches for mines-frequency rates-accident occurrence-investigation-measures for improving safety in mines-cost of accident-emergency preparedness – disaster management.

TOTAL: 45 PERIODS**OUTCOMES:**

- This course would make the student familiar with the concept of safety aspects in the mining industries.
- Course would be helpful in understanding the various types of mining activities like open case mines, underground mines and tunnel ling.
- The students will understand about the various risks involved in the mining activities and come to know about the various safety activities to be taken to ensure the safety of the workers.
- Students could able to implement the techniques like risk assessment Disaster management and emergency preparedness with the proper knowledge on accident prevention.
- Course would equip the students to effectively employ their knowledge on accident prevention in mines.

REFERENCES:

1. DGMS Circulars-Ministry of Labour, Government of India press, OR Lovely Prakashan - DHANBAD, 2002.
2. Kejriwal, B.K. Safety in Mines, Gyan Prakashan, Dhanbad, 2001.
3. "Mine Health and Safety Management", Michael Karmis ed., SME, Littleton, Co.2001.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	3	-	-	-	-
2	-	-	-	-	-	-
3	-	2	-	-	2	-
4	-	-	-	-	-	3
5	-	-	-	-	-	-
AVg.	-	$(3+2)/2=2.5$	$3/1=3$	-	$2/1=2$	$3/1=3$

1- low, 2-medium, 3-high, '-'- no correlation

IS4010**DOCK SAFETY****L T P C****3 0 0 3****OBJECTIVES:**

- To understand safety legislation related to dock activities in India.
- To understand the causes and effects of accidents during dock activities.
- To know the various material handling equipment and lifting appliances in dock.
- To know the safe working on board the ship and storage in the yards.
- To understand the safe operation of crane, portainers, lift trucks and container handling equipment.

UNIT I	HISTORY OF SAFETY LEGISLATION	9
<p>History of dock safety statues in India-background of present dock safety statues- dock workers (safety, health and welfare) act 1986 and the rules and regulations framed there under, other statues like marking of heavy packages act 1951 and the rules framed there under - manufacture, storage and import of hazardous chemicals. Rules 1989 framed under the environment (protection) act, 1989 – few cases laws to interpret the terms used in the dock safety statues.</p> <p>Responsibility of different agencies for safety, health and welfare involved in dock work – responsibilities of port authorities – dock labour board – owner of ship master, agent of ship – owner of lifting appliances and loose gear etc. – employers of dock workers like stevedores – clearing and forwarding agents – competent persons and dock worker. Forums for promoting safety and health in ports – Safe Committees and Advisory Committees. Their functions, training of dock workers.</p>		
UNIT II	WORKING ON BOARD THE SHIP	9
<p>Types of cargo ships – working on board ships – Safety in handling of hatch beams – hatch covers including its marking, Mechanical operated hatch covers of different types and its safety features – safety in chipping and painting operations on board ships – safe means of accesses – safety in storage etc. – illumination of decks and in holds – hazards in working inside the hold of the ship and on decks – safety precautions needed – safety in use of transport equipment - internal combustible engines like forklift trucks-pay loaders etc. Working with electricity and electrical management – Storage – types, hazardous cargo.</p>		
UNIT III	LIFTING APPLIANCES	9
<p>Different types of lifting appliances – construction, maintenance and use, various methods of rigging of derricks, safety in the use of container handling/lifting appliances like portainers, transtainer, top lift trucks and other containers – testing and examination of lifting appliances – portainers – transtainers – toplift trucks – derricks in different rigging etc.</p> <p>Use and care of synthetic and natural fiber ropes – wire rope chains, different types of slings and loose gears.</p>		
UNIT IV	TRANSPORT EQUIPMENT	9
<p>The different types of equipment for transporting containers and safety in their use-safety in the use of self loading container vehicles, container side lifter, fork lift truck, dock railways, conveyors and cranes.</p> <p>Safe use of special lift trucks inside containers – Testing, examination and inspection of containers – carriage of dangerous goods in containers and maintenance and certification of containers for safe operation</p> <p>Handling of different types of cargo – stacking and unstacking both on board the ship and ashore – loading and unloading of cargo identification of berths/walking for transfer operation of specific chemical from ship to shore and vice versa – restriction of loading and unloading operations.</p>		
UNIT V	EMERGENCY ACTION PLAN AND DOCK WORKERS (SHW) REGULATIONS 1990	9
<p>Emergency action Plans for fire and explosions - collapse of lifting appliances and buildings, sheds etc., - gas leakages and precautions concerning spillage of dangerous goods etc., - Preparation of on-site emergency plan and safety report.</p> <p>Dock workers (SHW) rules and regulations 1990-related to lifting appliances, Container handling, loading and unloading, handling of hatch coverings and beams, Cargo handling, conveyors, dock railways, forklift.</p>		
TOTAL: 45 PERIODS		

OUTCOMES:

- This course would make the student to familiar of various operations carried out in a dock.
- Students would know the different acts and rules for safe dock operations.
- Students could be able to understand the operation of various types of material handling equipments.
- Students would be prepared to response at the time of emergency in a dock.
- Students can recognize the various problems associated with the use of lifting equipments and in the storage yards.

REFERENCES

1. "Dock Safety" Thane Belapur Industries Association, Mumbai.
2. Bindra SR "Course in Dock and Harbour Engineering"
3. Safety and Health in Dock work, IInd Edition, ILO, 1992.
4. Srinivasan "Harbour, Dock and Tunnel Engineering"
5. Taylor D.A., "Introduction to Marine Engineering".

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	-	-	-	3	-
2	-	3	-	3	-	-
3	-	-	-	-	-	-
4	-	-	-	-	2	-
5	-	-	2	-	-	2
AVg.	-	3/1=3	2/1=2	3/1=3	(3+2)/2=2.5	2/1=2

1- low, 2-medium, 3-high, '-'- no correlation

IS4011

SAFETY IN ENGINEERING INDUSTRY

L T P C
3 0 0 3

OBJECTIVES:

- To know the safety rules and regulations, standards and codes
- To study various mechanical machines and their safety importance
- To understand the principles of machine guarding and operation of protective devices.
- To know the working principle of mechanical engineering processes such as metal forming and joining process and their safety risks.
- Developing the knowledge related to health and welfare measures in engineering industry

UNIT I SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES 9

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines,

Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards.

UNIT II PRINCIPLES OF MACHINE GUARDING

9

Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening.

Selection and suitability: lathe-drilling-boring-milling-grinding-shaping-sawing-shearing-presses-forge hammer-flywheels-shafts-couplings-gears-sprockets wheels and chains-pulleys and belts-authorized entry to hazardous installations-benefits of good guarding systems.

UNIT III SAFETY IN WELDING AND GAS CUTTING

9

Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-colour coding – flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders.

UNIT IV SAFETY IN COLD FORMING AND HOT WORKING OF METALS

9

Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes.

Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes, hazards and control measures.

Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes.

UNIT V SAFETY IN FINISHING, INSPECTION AND TESTING

9

Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation.

Health and welfare measures in engineering industry-pollution control in engineering industry-industrial waste disposal.

TOTAL: 45 PERIODS

OUTCOMES:

- Students can have the knowledge in safety rules, standards and codes in various mechanical engineering processes
- They can design machine guarding systems for various machines such as lathe, drilling, boring, milling etc.,
- They can implement the safety concepts in welding, gas cutting, storage and handling of gas cylinders, metal forming processes etc.,
- Students will have knowledge in testing and inspection as per rules in boilers, heat treatment operations etc.,
- They can take preventive measures in health and welfare of workers' aspects in engineering industry.

REFERENCES

1. "Accident Prevention Manual" – NSC, Chicago, 1982.
2. "Occupational safety Manual" BHEL, Trichy, 1988.
3. "Safety Management by John V. Grimaldi and Rollin H. Simonds, All India Travelers Book seller, New Delhi, 1989.
4. "Safety in Industry" N.V. Krishnan Jaico Publishery House, 1996.
5. Indian Boiler acts and Regulations, Government of India.
6. Safety in the use of wood working machines, HMSO, UK 1992.
7. Health and Safety in welding and Allied processes, welding Institute, UK, High Tech. Publishing Ltd., London, 1989.

CO-PO MAPPING:

CO	PO					
	1	2	3	4	5	6
1	-	3	-		3	-
2	-	-	-	3	-	3
3	-	3	-		-	-
4	-	-	-	-	2	-
5	-	-	-	-	-	3
AVg.	-	$(3+3)/2=3$	-	$3/1=3$	$(3+2)/2=2.5$	$(3+3)/2=3$

1- low, 2-medium, 3-high, '-'- no correlation

IS4012

QUALITY ENGINEERING IN PRODUCTION SYSTEMS

L T P C
3 0 0 3

OBJECTIVES:

- To know the quality engineering concepts in product design and development processes.
- To know the control and process parameters' characteristics with feedback system.
- To know the methods for production and diagnosis process improvements.
- To have knowledge on ISO quality systems and types of quality tools such as failure and effect analysis.
- To understand the six-sigma concepts and its implementation in engineering industries.

UNIT I INTRODUCTION TO QUALITY ENGINEERING AND LOSS FUNCTION 9

Quality value and engineering- overall quality system-quality engineering in product design - quality engineering in design of production processes - quality engineering in production - quality engineering in service. Loss function Derivation – use-loss function for products/system- justification of improvements-loss function and inspection- quality evaluations and tolerances-N type, S type, L type.

UNIT II ON-LINE QUALITY CONTROL 9

On-line feedback quality control variable characteristics-control with measurement interval- one unit, multiple units-control systems for lot and batch production. On-line process parameter control variable characteristics- process parameter tolerances- feedback control systems-measurement error and process control parameters.

UNIT III ON-LINE QUALITY CONTROL ATTRIBUTES AND METHODS FOR PROCESS IMPROVEMENTS 9

Checking intervals- frequency of process diagnosis. Production process improvement method- process diagnosis improvement method- process adjustment and recovery improvement methods.

UNIT IV QUALITY ENGINEERING AND TPM 9

Preventive maintenance schedules- PM schedules for functional characteristics- PM schedules for large scale systems. Quality tools–fault tree analysis, event tree analysis, failure mode and effect analysis. ISO quality systems.

UNIT V SIX SIGMA AND ITS IMPLEMENTATION 9

Introduction- definition-methodology- impact of implementation of six sigma-DMAIC method-roles and responsibilities –leaders, champion, black belt, green belts. Do's and dont's - readiness of organization – planning-management role- six sigma tools – sustaining six sigma.

TOTAL: 45 PERIODS

OUTCOMES:

1. Students can understand the loss function derivation and quality engineering in product design and development processes.
2. Students can develop their knowledge in online quality control systems and process an control parameters.
3. The students will be able to improve the production and process diagnosis and production process.
4. The students will be able to gain knowledge in ISO quality management systems.
5. The students will be able to list the roles and responsibilities of leaders.

REFERENCES:

1. Brue G, "Six Sigma for Managers", Tata-McGraw Hill, New Delhi, Second reprint, 2002.
2. De Feo J A and Barnard W W, "Six Sigma: Breakthrough and Beyond", Tata McGraw-Hill, New Delhi, 2005.
3. Pyzdek T and Berger R W,"Quality Engineering Handbook", Tata-McGraw Hill, New Delhi, 1996
4. Taguchi G, Elsayed E A and Hsiang, T.C., "Quality Engineering in Production Systems", Mc-Graw-Hill Book company, Singapore, International Edition, 1989

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	3	-	2	-	-	-
2	2	-	3	-	3	-
3	-	3	-	-	-	-
4	-	2	-	-	-	-
5	-	-	-	2	-	-
AVg.	$(3+2)/2=2.5$	$(3+2)/2=2.5$	$(2+3)/2=2.5$	$3/1=3$	$3/1=3$	-

1- low, 2-medium, 3-high, '-'- no correlation

OBJECTIVES:

- The course could provide the basic knowledge on Occupational Health and Safety Management System and Environmental Management System standards.
- To inculcate the knowledge on various terms and terminologies which are used in the Occupational Health, Safety and Environmental Management system.
- To educate about the various steps to be taken for certification of ISO 45001(Occupational health and safety management systems) and ISO14001 (Environmental Management Systems) standards.
- To impart knowledge on Environment Impact Assessment (EIA), Life Cycle Assessment of product and principles of Eco labelling.

UNIT I OH & S MANAGEMENT SYSTEM STANDARD 9

Introduction to ISO 45001 – Development of various OHSMS standards – aim of OH & S management system–success factors– plan do check act cycle- contents and scope of ISO 45001-terms and definitions –leadership and worker participation –leadership and commitment - OH & S policy- organizational roles and responsibilities and authorities – consultation and participation of workers

UNIT II PLANNING 9

Actions to address risk and opportunities – hazard identification and assessment of risks and opportunities –determination of legal and other requirements-planning action- OH & S objectives and planning to achieve them- support – resources – competence –awareness- communication – documented information –operation planning & control –management of change – procurement – Emergency preparedness and response.

UNIT III PERFORMANCE EVALUATION 9

Monitoring , measurement , analysis and performance evaluation -evaluation of compliance-Internal audit-management review- Improvement- Incident, nonconformity and corrective action – continual improvement- guidance of the use of the document ISO 45001 - benefits of certification-certification procedure.

UNIT IV ISO 14001& ISO 19011 9

EMS, ISO 14001, specifications, objectives, Environmental Policy, Guidelines and Principles (ISO 14004), clauses 4.1 to 4.5. Documentation requirements, 3 levels of documentation for a ISO 14000 based EMS, steps in ISO 14001.

Implementation plan, Registration, Importance of ISO 14000 to the Management. Auditing ISO14000-General principles of Environmental Audit, Auditor, steps in audit, Audit plan.

ISO 19011- Guidelines for auditing management Systems-General principles, managing audit programme- audit activities, steps in audit, audit plan-competence of auditors.

UNIT V ENVIRONMENT IMPACT ASSESSMENT 9

ISO 14040(LCA), General principles of LCA, Stages of LCA, Report and Review. ISO 14020 (Eco labeling) – History, 14021, 14024, Type I labels, Type II labels, ISO 14024, principles, rules for eco labeling before company attempts for it. Advantages. EIA in EMS, Types of EIA, EIA methodology EIS, Scope, Benefits.

Audit-methodology, Auditors Audit results management review-Continual improvement.

TOTAL: 45 PERIODS

OUTCOMES:

- The student would be able to remember the various standards which is meant mainly for maintaining the Health of the employee and for the maintenance of the Environment.
- The student could be able to understand the basic difference between the ISO 9000 series and ISO 45001 and ISO 14000 standards and the various clauses which governs the system in maintaining the standard.
- The course could provide the sufficient knowledge on various clauses and subsequent preparation of procedures and related documents and could be able to apply their knowledge in preparing the ISO manual for getting the certification from the external certifying agencies.
- Course could help the students in acquiring the knowledge on various standards and provide the skill in analysing the various clauses and its suitability and applicability on the nature of organization.

REFERENCES:

1. ISO 45001: 2018 –Occupational Health and safety management systems Requirements with guidance for use
2. ISO14001:2004, Environmental Management Systems Requirements with Guidance for Use” ,ISO,2004.
3. “Guidelines on Occupational Health and Safety Management Systems (OSH-MS)” International Labour Organization, 2001.
4. “BS 8800: 2004 Occupational Health and Safety Management Systems-Guide” BSI, UK, 2004.
5. “ISO 19011:2011 Guidelines for Auditing Management Systems”, ISO, 2011.
6. “ISO 14040:2006 Environmental Management- Life Cycle Assessment - Principles and Framework” ISO,2006.
7. “ISO 14025:2006 Environmental Labels and Declarations -Type III Environmental Declarations - Principles andProcedures”, ISO,2006.
8. “ISO 14021:1999 Environmental Labels and Declarations - Self-Declared Environmental Claims (Type II environmental labelling)”, ISO, 1999.
9. “ISO 14020:2000 Environmental Labels and Declarations-General Principles”, ISO, 2000.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	3	2	-	-	2
2	-	-	3	-	-	-
3	-	3	-	3	-	-
4	-	-	-	-	2	-
5	-	-	-	-	-	-
AVg.	-	$(3+3)/2=3$	$(2+3)/2=2.5$	$3/1=3$	$2/1=2$	$2/1=2$

1- low, 2-medium, 3-high, ‘-’- no correlation

OBJECTIVES:

- To know the fundamental concepts and applications of Artificial intelligence.
- To familiarize with AI languages like PROLOG and LISP.
- To understand the various features of expert system
- To have knowledge about Neural Network and corresponding selection of parameters.

UNIT I INTRODUCTION**9**

Intelligence – Definition, types cognitive aspect approach, measuring intelligence – early efforts, IQ and AI: aspects of intelligence – learning, problem solving, creativity, behaviour and biology. Artificial intelligence: Historical background, applications of AI, objections and myths, AI languages: Introduction to PROLOG and LISP.

UNIT II COGNITIVE PSYCHOLOGY**11**

The mind – informative and cybernetics, components for thought, modes of perception – visual, auditory and other systems: memory mechanisms, problem solving – planning, search, the GPS systems; types of learning – rote, parameter, method and concept: Game playing, reasoning, Artificial Vision – picture processing – identifying real objects; Vision programs, factory vision systems.

UNIT III KNOWLEDGE ENGINEERING**9**

Introduction – role of knowledge engineer, knowledge representation – psychology, production rules, logic and programming, Common sense and fuzzy logic, semantic networks, learning systems.

UNIT IV EXPERT SYSTEMS**9**

Introduction, knowledge acquisition for Expert system, features of Expert systems –System structure, inference Engines, uncertainties, memory mechanisms, range of applications, actual expert systems – VP expert. Assignment – Development of a simple expert system.

UNIT V INTRODUCTION TO NEURAL NETWORKS**7**

Neural Network Architecture – Learning methods – Architecture of a Back Propagation Network – Selection of parameters – Simple variations of BPN.

TOTAL: 45 PERIODS**OUTCOMES:**

- To apply various aspects of intelligence to diverse industrial situations
- To list out the applications of expert system To develop a simple expert system related to industrial safety Engineering.
- To apply neural network concepts in safety engineering discipline.

REFERENCES:

1. Charnaik, E., and McDermott, D., "Introduction to Artificial Intelligence", Addison Wesley, 1985.
2. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", Prentice Hall of India, 1992.
3. Elaine R., and Kevin, "Artificial Intelligence", 2nd Edition, Tata McGraw Hill, 1994.
4. Nilsson, N.J., "Principles of AI", Narosa Publishing House, 1990.
5. Rajasekaran S and Vijayalakshmi Pai, G.A, "Neural Networks, Fuzzy Logic and Genetic Algorithms – Synthesis and Applications", PHI, 2003.
6. Schalkoff, R.J., "Artificial Intelligence" – An Engineering Approach", McGraw Hill International Edition, Singapore, 1992.
7. Winston, P.H., "Artificial Intelligence", Addison Wesley, 1990.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	3	-	2	-	-	-
2	3	3	3	-	-	-
3	-	2	-	-	-	3
4	-	-	-	-	-	-
5	-	-	-	-	-	-
AVg.	$(3+3)/2=3$	$(3+2)/2=2.5$	$(2+3)/2=2.5$	-	-	$3/1=3$

1- low, 2-medium, 3-high, ‘-‘- no correlation

IL4091

DESIGN OF EXPERIMENTS

L T P C
3 0 0 3

OBJECTIVES:

- Impart knowledge on principles and steps in designing a statistically designed experiment.
- Build foundation in analysing the data in single factor experiments and to perform post hoc tests.
- Provide knowledge on analysing the data in factorial experiments.
- Educate on analysing the data analysis in special experimental designs and Response Surface Methods.
- Impart knowledge in designing and analysing the data in Taguchi's Design of Experiments to improve Process/Product quality.

UNIT I EXPERIMENTAL DESIGN FUNDAMENTALS 9
Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot, linear regression models.

UNIT II SINGLE FACTOR EXPERIMENTS 9
Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests.

UNIT III MULTIFACTOR EXPERIMENTS 9
Two and three factor full factorial experiments, Randomized block factorial design, Experiments with random factors, rules for expected mean squares, approximate F- tests. 2^k factorial Experiments.

UNIT IV SPECIAL EXPERIMENTAL DESIGNS: 9
Blocking and confounding in 2^k designs. Two level Fractional factorial design, nested designs, Split plot design, Introduction to Response Surface Methods.

UNIT V TAGUCHI METHODS 9
Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design- control and noise factors, S/N ratios, parameter design, Multi-level experiments, Multi-response optimization, Introduction to Shainin DOE.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Understand the fundamental principles of Design of Experiments.

CO2: Analyze data in the single factor experiments.

CO3: Analyze data in the multifactor experiments.

CO4: Understand the special experimental designs & Response Surface Methods.

CO5: Apply Taguchi based approach to evaluate quality.

REFERENCES:

1. Krishnaiah, K. and Shahabudeen, P. Applied Design of Experiments and Taguchi Methods, PHI learning private Ltd., 2012.
2. Montgomery, D.C., Design and Analysis of experiments, John Wiley and Sons, Eighth edition, 2012.
3. NicoloBelavendram, Quality by Design; Taguchi techniques for industrial experimentation, Prentice Hall, 1995.
4. Phillip J.Rose, Taguchi techniques for quality engineering, McGraw Hill, 1996.
5. Montgomery, D.C., Design and Analysis of Experiment, Minitab Manual, John Wiley and Sons, Seventh edition, 2010.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	-	-	-	-
CO2	-	-	1	1	-	-
CO3	-	-	1	1	-	-
CO4	-	-	1	1	1	-
CO5	2	1	1	-	-	-
Avg.	$(1+2)/2=1.5$	$(1+1)/2=1$	$(1+1+1+1)/4=1$	$(1+1+1)/3=1$	$1/1=1$	-

1- low, 2-medium, 3-high, ‘-‘- no correlation

IS4071

DATA ANALYTICS
PROGRESS THROUGH KNOWLEDGE

L T P C
3 0 0 3

COURSE OBJECTIVES:

1. Recognize the importance of data analytics
2. Exhibit competence on data analytics packages
3. Apply solution methodologies for industrial problems.

UNIT I**INTRODUCTION**

9

Introduction to Multivariate Statistics-Degree of Relationship among Variables-Review of Univariate and Bivariate Statistics-Screening Data Prior to Analysis-Missing Data, Outliers, Normality, Linearity, and Homoscedasticity.

UNIT II**MULTIPLE REGRESSION**

9

Multiple Regression- Linear and Nonlinear techniques- Backward-Forward-Stepwise Hierarchical regression-Testing interactions (2way interaction) - Analysis of Variance and Covariance (ANOVA & ANCOVA) - Multivariate Analysis of Variance and Covariance (MANOVA & MANCOVA).

UNIT III LOGISTIC REGRESSION 9
 Regression with binary dependent variable -Simple Discriminant Analysis Multiple Discriminant analysis-Assessing classification accuracy- Conjoint analysis (Full profile method).

UNIT IV PRINCIPAL COMPONENT ANALYSIS 9
 Principal Component Analysis -Factor Analysis- Orthogonal and Oblique Rotation-Factor Score Estimation-Multidimensional Scaling-Perceptual Map-Cluster Analysis (Hierarchical Vs Nonhierarchical Clustering).

UNIT V LATENT VARIABLE MODELS 9
 Latent Variable Models an Introduction to Factor, Path, and Structural Equation Analysis- Time series data analysis (ARIMA model) – Decision tree analysis (CHAID, CART) - Introduction to Big Data Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student will be able to:

- To recognize the importance of data analytics
- To Exhibit competence on data analytics packages
- To apply solution methodologies for industrial problems.

REFERENCES:

1. Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. "Multivariate data analysis", (7th edition). Pearson India. 2015
2. Tabachnick, B. G., & Fidell, L. S., "Using multivariate statistics", (5th edition). Pearson Prentice Hall, 2001
3. Gujarati, D. N. , "Basic econometrics", Tata McGraw-Hill Education, 2012
4. Malhotra, N. K., " Marketing research: An applied orientation", 5/e. Pearson Education India, 2008
5. Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. " Applied multiple regression/correlation analysis for the behavioral sciences", Routledge., 2013
6. Han, J., Kamber, M., & Pei, J. "Data mining: concepts and techniques: concepts and techniques", Elsevier, 2011.

CO	PO					
	1	2	3	4	5	6
1	1	1	1	1	1	1
2	1	1	1	1	1	1
3	1	1	1	1	1	1
AVG	1	1	1	1	1	1

1-low, 2-medium, 3-high, ‘-‘- no correlation

AUDIT COURSES

AX4091

ENGLISH FOR RESEARCH PAPER WRITING

L T P C
2 0 0 0

OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING

6

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

UNIT II PRESENTATION SKILLS

6

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

UNIT III TITLE WRITING SKILLS

6

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, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS

6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS

6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

COURSE OUTCOMES

- CO1 – Understand that how to improve your writing skills and level of readability
- CO2 – Learn about what to write in each section
- CO3 – Understand the skills needed when writing a Title
- CO4 – Understand the skills needed when writing the Conclusion
- CO5 – Ensure the good quality of paper at very first-time submission

REFERENCES

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

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6

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

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

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.

UNIT III DISASTER PRONE AREAS IN INDIA 6

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT 6

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

TOTAL : 30 PERIODS**COURSE OUTCOMES**

CO1: Ability to summarize basics of disaster

CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO5: Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCES:

1. Goel S. L., Disaster Administration And Management Text And Case Studies”,Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, “Disaster Management in India: Perspectives, issues and strategies “NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ,” Disaster Mitigation Experiences And Reflections”, Prentice Hall of India, New Delhi,2001.

AX4093

CONSTITUTION OF INDIA

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OBJECTIVES

Students will be able to:

- 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 nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND 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.

UNIT IV 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.

UNIT V LOCAL ADMINISTRATION

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

UNIT VI ELECTION COMMISSION

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

TOTAL: 30 PERIODS

OUTCOMES:

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING

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

AX4094

நற்றமிழ் இலக்கியம்

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UNIT I

சங்க இலக்கியம்

6

1. தமிழின் துவக்க நூல் தொல்காப்பியம்
- எழுத்து, சொல், பொருள்
2. அகநானூறு (82)
- இயற்கை இன்னிசை அரங்கம்
3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி
4. புறநானூறு (95,195)
- போரை நிறுத்திய ஓளவையார்

UNIT II

அறநெறித் தமிழ்

6

1. அறநெறி வகுத்த திருவள்ளுவர்
- அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புரவறிதல், ஈகை, புகழ்
2. பிற அறநூல்கள் - இலக்கிய மருந்து
- ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல்)

UNIT III

இரட்டைக் காப்பியங்கள்

6

1. கண்ணகியின் புரட்சி
- சிலப்பதிகார வழக்குரை காதை
சமூகசேவை இலக்கியம் மணிமேகலை
- சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை

UNIT IV

அருள்நெறித் தமிழ்

6

1. சிறுபாணாற்றுப்படை

- பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குத் போர்வை கொடுத்தது, அதியமான் ஓளவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள்
- 2. நற்றிணை
 - அன்னைக்குரிய புன்னை சிறப்பு
- 3. திருமந்திரம் (617, 618)
 - இயமம் நியமம் விதிகள்
- 4. தர்மச்சாலையை நிறுவிய வள்ளலார்
- 5. புறநானூறு
 - சிறுவனே வள்ளலானான்
- 6. அகநானூறு (4) - வண்டு
 நற்றிணை (11) - நண்டு
 கலித்தொகை (11) - யானை, புறா
 ஐந்திணை 50 (27) - மான்
 ஆகியவை பற்றிய செய்திகள்

UNIT V

நவீன தமிழ் இலக்கியம்

6

1. உரைநடைத் தமிழ்,
 - தமிழின் முதல் புதினம்,
 - தமிழின் முதல் சிறுகதை,
 - கட்டுரை இலக்கியம்,
 - பயண இலக்கியம்,
 - நாடகம்,
2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும்,
3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும்,
4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும்,
5. அறிவியல் தமிழ்,
6. இணையத்தில் தமிழ்,
7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.

TOTAL: 30 PERIODS

தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்

1. தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University) - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia) - <https://ta.wikipedia.org>
3. தர்மபுர ஆதீன வெளியீடு
4. வாழ்வியல் களஞ்சியம் - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்
5. தமிழ்கலைக் களஞ்சியம் - தமிழ் வளர்ச்சித் துறை (thamilvalarchithurai.com)
6. அறிவியல் களஞ்சியம் - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்

OBJECTIVE

- Students will be introduced to the concepts and principles of IWRM, which is inclusive of the economics, public-private partnership, water & health, water & food security and legal & regulatory settings.

UNIT I CONTEXT FOR IWRM 9

Water as a global issue: key challenges – Definition of IWRM within the broader context of development – Key elements of IWRM - Principles – Paradigm shift in water management - Complexity of the IWRM process – UN World Water Assessment - SDGs.

UNIT II WATER ECONOMICS 9

Economic view of water issues: economic characteristics of water good and services – Non-market monetary valuation methods – Water economic instruments – Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies.

UNIT III LEGAL AND REGULATORY SETTINGS 9

Basic notion of law and governance: principles of international and national law in the area of water management - Understanding UN law on non-navigable uses of international water courses – International law for groundwater management – World Water Forums – Global Water Partnerships - Development of IWRM in line with legal and regulatory framework.

UNIT IV WATER AND HEALTH WITHIN THE IWRM CONTEXT 9

Links between water and health: options to include water management interventions for health – Health protection and promotion in the context of IWRM – Global burden of Diseases - Health impact assessment of water resources development projects – Case studies.

UNIT V AGRICULTURE IN THE CONCEPT OF IWRM 9

Water for food production: ‘blue’ versus ‘green’ water debate – Water foot print - Virtual water trade for achieving global water and food security – Irrigation efficiencies, irrigation methods - current water pricing policy– scope to relook pricing.

TOTAL: 45 PERIODS**OUTCOMES**

- On completion of the course, the student is expected to be able to

CO1	Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.
CO2	Select the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.
CO3	Apply law and governance in the context of IWRM.
CO4	Discuss the linkages between water-health; develop a HIA framework.
CO5	Analyse how the virtual water concept pave way to alternate policy options.

REFERENCES:

1. Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003.
2. Mollinga .P. etal “ Integrated Water Resources Management”, Water in South Asia Volume I, Sage Publications, 2006.
3. Technical Advisory Committee, Integrated Water Resources management, Technical Advisory Committee Background Paper No: 4. Global water partnership, Stockholm, Sweden. 2002.
4. Technical Advisory Committee, Dublin principles for water as reflected in comparative assessment of institutional and legal arrangements for Integrated Water Resources Management, Technical Advisory Committee Background paper No: 3. Global water partnership, Stockholm, Sweden. 1999.
5. Technical Advisory Committee, Effective Water Governance”. Technical Advisory Committee Background paper No: 7. Global water partnership, Stockholm, Sweden, 2003.

CO – PO Mapping - INTEGRATED WATER RESOURCES MANAGEMENT

POs/PSOs		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	3	2	2	2	2	2
PO2	Problem analysis	1	3	2	2	2	2
PO3	Design / development of solutions		2	2	2	2	2
PO4	Investigation	1	2			1	1
PO5	Modern Tool Usage	1	1	2	1	1	1
PO6	Individual and Team work		2	2			2
PO7	Communication		2	2			2
PO8	Engineer and Society	2	2	3	2	3	3
PO9	Ethics		2	3	2	2	2
PO10	Environment and Sustainability	3	3	3	3	3	3
PO11	Project Management and Finance	1	1	1		1	1
PO12	Life Long Learning		2	2	2	2	2
PSO1	Knowledge of field research methodology, gender, legal and environmental aspects in the context of integrated water resources management	3	2	2	2	2	2
PSO2	Formulate, analyze and comprehend the differences in social and environmental variability in South Indian context with their peers and strive to work towards sustainability	2	2	2	2	2	2
PSO3	Produce and publish professional reports, peer-reviewed journal, on contemporary and state of the art research in integrated water resources management	2	2	2	2	2	2

OBJECTIVES:

- Understand the accelerating health impacts due to the present managerial aspects and initiatives in water and sanitation and health sectors in the developing scenario

UNIT I FUNDAMENTALS WASH 9

Meanings and Definition: Safe Water- Health, Nexus: Water- Sanitation - Health and Hygiene – Equity issues-Water security - Food Security. Sanitation And Hygiene (WASH) and Integrated Water Resources Management (IWRM) - Need and Importance of WASH

UNIT II MANAGERIAL IMPLICATIONS AND IMPACT 9

Third World Scenario – Poor and Multidimensional Deprivation--Health Burden in Developing Scenario -Factors contribute to water, sanitation and hygiene related diseases-Social: Social Stratification and Literacy Demography: Population and Migration- Fertility - Mortality- Environment: Water Borne-Water Washed and Water Based Diseases - Economic: Wage - Water and Health Budgeting -Psychological: Non-compliance - Disease Relapse - Political: Political Will.

UNIT III CHALLENGES IN MANAGEMENT AND DEVELOPMENT 9

Common Challenges in WASH - Bureaucracy and Users- Water Utilities -Sectoral Allocation:- Infrastructure- Service Delivery: Health services: Macro and Micro- level: Community and Gender Issues- Equity Issues - Paradigm Shift: Democratization of Reforms and Initiatives.

UNIT IV GOVERNANCE 9

Public health -Community Health Assessment and Improvement Planning (CHA/CHIP)-Infrastructure and Investments on Water, (WASH) - Cost Benefit Analysis – Institutional Intervention-Public Private Partnership - Policy Directives - Social Insurance -Political Will vs Participatory Governance -

UNIT V INITIATIVES 9

Management vs Development -Accelerating Development- Development Indicators -Inclusive Development-Global and Local- Millennium Development Goal (MDG) and Targets - Five Year Plans - Implementation - Capacity Building - Case studies on WASH.

TOTAL: 45 PERIODS**OUTCOMES:**

CO1	Capture to fundamental concepts and terms which are to be applied and understood all through the study.
CO2	Comprehend the various factors affecting water sanitation and health through the lens of third world scenario.
CO3	Critically analyse and articulate the underlying common challenges in water, sanitation and health.
CO4	Acquire knowledge on the attributes of governance and its say on water sanitation and health.
CO5	Gain an overarching insight in to the aspects of sustainable resource management in the absence of a clear level playing field in the developmental aspects.

REFERENCES

1. Bonitha R., Beaglehole R., Kjellstorm, 2006, "Basic Epidemiology", 2nd Edition, World Health Organization.
2. Van Note Chism, N. and Bickford, D. J. (2002), Improving the environment for learning: An expanded agenda. *New Directions for Teaching and Learning*, 2002: 91–98. doi: 10.1002/tl.83
3. National Research Council. *Global Issues in Water, Sanitation, and Health: Workshop Summary*. Washington, DC: The National Academies Press, 2009.
4. Sen, Amartya 1997. *On Economic Inequality*. Enlarged edition, with annex by James Foster and Amartya Sen, Oxford: Clarendon Press, 1997.
5. *Intersectoral Water Allocation Planning and Management*, 2000, World Bank Publishers www.amazon.com
6. Third World Network.org (www.twn.org).

CO PO MAPPING : WATER, SANITATION AND HEALTH

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences		1	1	M	1	1
PO2	Problem analysis		2	2	2	2	2
PO3	Design / development of solutions			2	1	2	2
PO4	Investigation		2	3	3	3	3
PO5	Modern Tool Usage				1		1
PO6	Individual and Team work		2	2	1	2	2
PO7	Communication				2	2	2
PO8	Engineer and Society		3	3	3	3	3
PO9	Ethics			1	2	2	2
PO10	Environment and Sustainability		3			3	3
PO11	Project Management and Finance					1	1
PO12	Life Long Learning	2	3	2	3	3	3
PSO1	Explain the concepts of water management, field research methodology, gender, legal and environmental aspects in the context of integrated water resources management		3	3	3	3	3
PSO2	Formulate, analyse and comprehend the differences in social and economic variability in South Asian context with their peers and strive to work towards sustainability.		3	2	3	3	3
PSO3	Produce and publish professional reports, peer reviewed journal on contemporary and state of art research in water resources Engineering.		3	3	3	2	3

OBJECTIVES:

- To impart knowledge on environmental, social and economic dimensions of sustainability and the principles evolved through landmark events so as to develop an action mindset for sustainable development.

UNIT I SUSTAINABILITY AND DEVELOPMENT CHALLENGES 9

Definition of sustainability – environmental, economical and social dimensions of sustainability - sustainable development models – strong and weak sustainability – defining development- millennium development goals – mindsets for sustainability: earthly, analytical, precautionary, action and collaborative– syndromes of global change: utilisation syndromes, development syndromes, and sink syndromes – core problems and cross cutting Issues of the 21 century - global, regional and local environmental issues – social insecurity - resource degradation –climate change – desertification.

UNIT II PRINCIPLES AND FRAME WORK 9

History and emergence of the concept of sustainable development - our common future - Stockholm to Rio plus 20– Rio Principles of sustainable development – Agenda 21 natural step- peoples earth charter – business charter for sustainable development –UN Global Compact - Role of civil society, business and government – United Nations’ 2030 Agenda for sustainable development – 17 sustainable development goals and targets, indicators and intervention areas

UNIT III SUSTAINABLE DEVELOPMENT AND WELLBEING 9

The Unjust World and inequities - Quality of Life - Poverty, Population and Pollution - Combating Poverty - - Demographic dynamics of sustainability - Strategies to end Rural and Urban Poverty and Hunger – Sustainable Livelihood Framework- Health, Education and Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities and Industry for Prevention, Precaution , Preservation and Public participation.

UNIT IV SUSTAINABLE SOCIO-ECONOMIC SYSTEMS 10

Sustainable Development Goals and Linkage to Sustainable Consumption and Production – Investing in Natural Capital- Agriculture, Forests, Fisheries - Food security and nutrition and sustainable agriculture- Water and sanitation - Biodiversity conservation and Ecosystem integrity –Ecotourism - Sustainable Cities – Sustainable Habitats- Green Buildings - Sustainable Transportation — Sustainable Mining - Sustainable Energy– Climate Change –Mitigation and Adaptation - Safeguarding Marine Resources - Financial Resources and Mechanisms

UNIT V ASSESSING PROGRESS AND WAY FORWARD 8

Nature of sustainable development strategies and current practice- Sustainability in global, regional and national context –Approaches to measuring and analysing sustainability– limitations of GDP- Ecological Footprint- Human Development Index- Human Development Report – National initiatives for Sustainable Development - Hurdles to Sustainability - Science and Technology for sustainable development –Performance indicators of sustainability and Assessment mechanism – Inclusive Green

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1	Explain and evaluate current challenges to sustainability, including modern world social, environmental, and economic structures and crises.
CO2	Identify and critically analyze the social environmental, and economic dimensions of sustainability in terms of UN Sustainable development goals
CO3	Develop a fair understanding of the social, economic and ecological linkage of Human well being, production and consumption
CO4	Evaluate sustainability issues and solutions using a holistic approach that focuses on connections between complex human and natural systems.
CO5	Integrate knowledge from multiple sources and perspectives to understand environmental limits governing human societies and economies and social justice dimensions of sustainability.

REFERENCES:

1. Tom Theis and Jonathan Tomkin, *Sustainability: A Comprehensive Foundation*, Rice University, Houston, Texas, 2012
2. *A guide to SDG interactions:from science to implementation*, International Council for Science, Paris,2017
3. Karel Mulder, *Sustainable Development for Engineers - A Handbook and Resource Guide*, Rouledge Taylor and Francis, 2017.
4. *The New Global Frontier - Urbanization, Poverty and Environmentin the 21st Century - George Martine,Gordon McGranahan,Mark Montgomery and Rogelio Fernández-Castilla*, IIED and UNFPA, Earthscan, UK, 2008
5. Nolberto Munier, *Introduction to Sustainability: Road to a Better Future*, Springer, 2006
6. Barry Dalal Clayton and Stephen Bass, *Sustainable Development Strategies- a resource book*”, Earthscan Publications Ltd, London, 2002.

CO – PO Mapping –Principles of Sustainable Development

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences						
PO2	Problem analysis	3	3				3
PO3	Design / development of solutions				3	3	3
PO4	Investigation		2	2	2	2	2
PO5	Modern Tool Usage						
PO6	Individual and Team work		2	2			2
PO7	Communication					1	1
PO8	Engineer and Society	3			3		3
PO9	Ethics				2	2	2
PO10	Environment and Sustainability	3	3	3	3	3	3
PO11	Project Management and Finance						
PO12	Life Long Learning					1	1
PSO1	Knowledge of Environmental Management discipline	3	3	3	3		3

PSO2	Environmental Performance Evaluation and coordination						
PSO3	Conceptualization of Environmental Management Systems						

OCE434

ENVIRONMENTAL IMPACT ASSESSMENT

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OBJECTIVES:

- To make the students to understand environmental clearance, its legal requirements and to provide knowledge on overall methodology of EIA, prediction tools and models, environmental management plan and case studies.

UNIT I INTRODUCTION

9

Historical development of Environmental Impact Assessment (EIA). Environmental Clearance- EIA in project cycle. legal and regulatory aspects in India – types and limitations of EIA –EIA process- screening – scoping - terms of reference in EIA- setting – analysis – mitigation. Cross sectoral issues –public hearing in EIA- EIA consultant accreditation.

UNIT II IMPACT IDENTIFICATION AND PREDICTION

10

Matrices – networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modeling for impact prediction – assessment of impacts – air – water – soil – noise – biological — cumulative impact assessment

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT

8

Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation

UNIT IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN

9

Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment

UNIT V CASE STUDIES

9

Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1	Understand need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles
CO2	Understand various impact identification methodologies, prediction techniques and model of impacts on various environments
CO3	Understand relationship between social impacts and change in community due to development activities and rehabilitation methods

CO4	Document the EIA findings and prepare environmental management and monitoring plan
CO5	Identify, predict and assess impacts of similar projects based on case studies

REFERENCES:

1. EIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India
2. Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India
3. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996
4. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003
5. Lee N. and George C. 2000. Environmental Assessment in Developing and Transitional Countries. Chichester: Willey
6. World Bank –Source book on EIA ,1999
7. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification Assessment and Control, 4th Edition, Butterworth Heineman, 2012.

CO – PO Mapping- ENVIRONMENTAL IMPACT ASSESSMENT

PO/PSO		Course Outcome					Overall Correlation of COs to Pos
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences		3			3	3
PO2	Problem analysis		2	2			2
PO3	Design / development of solutions		3	3	3		3
PO4	Investigation		2	2		2	2
PO5	Modern Tool Usage		2	2	3		2
PO6	Individual and Team work		2	2	2		2
PO7	Communication				1		1
PO8	Engineer and Society	2			2		2
PO9	Ethics	3	3	3	2	2	3
PO10	Environment and Sustainability	3			2		2
PO11	Project Management and Finance				1		L
PO12	Life Long Learning		1	1			L
PSO1	Knowledge of Environmental Engineering discipline	2					2
PSO2	Environmental Performance Evaluation and coordination		2	2	2		2
PSO3	Conceptualization of Environmental Engineering Systems		2		2		2

OIC431

BLOCKCHAIN TECHNOLOGIES

**LT PC
3 0 0 3**

COURSE OBJECTIVES:

- This course is intended to study the basics of Blockchain technology.
- During this course the learner will explore various aspects of Blockchain technology like application in various domains.
- By implementing, learners will have idea about private and public Blockchain, and smart contract.

UNIT I INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN 9
 Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

UNIT II BITCOIN AND CRYPTOCURRENCY 9
 Introduction to Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain and Digital Currency, Transactional Blocks, Impact of Blockchain Technology on Cryptocurrency.

UNIT III INTRODUCTION TO ETHEREUM 9
 Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, Transactions, Receiving Ethers, Smart Contracts.

UNIT-IV INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING 10
 Introduction to Hyperledger, Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer. Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types.

UNIT V BLOCKCHAIN APPLICATIONS 8
 Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After the completion of this course, student will be able to

CO1: Understand and explore the working of Blockchain technology

CO2: Analyze the working of Smart Contracts

CO3: Understand and analyze the working of Hyperledger

CO4: Apply the learning of solidity to build de-centralized apps on Ethereum

CO5: Develop applications on Blockchain

REFERENCES:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.
2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction" Princeton University Press, 2016
3. Antonopoulos, Mastering Bitcoin, O'Reilly Publishing, 2014. .
4. Antonopoulos and G. Wood, "Mastering Ethereum: Building Smart Contracts and Dapps", O'Reilly Publishing, 2018.
5. D. Drescher, Blockchain Basics. Apress, 2017.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	2	1	3	2	2	3
2	2	1	2	3	2	2
3	2	1	3	1	2	1
4	2	1	2	3	2	2
5						
Avg	2.00	1.00	2.50	2.25	2.00	2.00

COURSE OBJECTIVES:

- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- Build and train RNNs, work with NLP and Word Embeddings
- The internal structure of LSTM and GRU and the differences between them
- The Auto Encoders for Image Processing

UNIT I DEEP LEARNING CONCEPTS**6**

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

UNIT II NEURAL NETWORKS**9**

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting. Hyperparameters.

UNIT III CONVOLUTIONAL NEURAL NETWORK**10**

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. R-CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO

UNIT VI NATURAL LANGUAGE PROCESSING USING RNN**10**

About NLP & its Toolkits. Language Modeling . Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Co-occurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN) . Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.

UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING**10**

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification. Denoising Autoencoders. Sparse Autoencoders

COURSE OUTCOMES:

CO1: Feature Extraction from Image and Video Data

CO2: Implement Image Segmentation and Instance Segmentation in Images

CO3: Implement image recognition and image classification using a pretrained network (Transfer Learning)

CO4: Traffic Information analysis using Twitter Data

CO5: Autoencoder for Classification & Feature Extraction

TOTAL : 45 PERIODS

REFERENCES

1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017
5. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017

OBA431

SUSTAINABLE MANAGEMENT

LT P C

3 0 0 3

COURSE OBJECTIVES:

- To provide students with fundamental knowledge of the notion of corporate sustainability.
- To determine how organizations impacts on the environment and socio-technical systems, the relationship between social and environmental performance and competitiveness, the approaches and methods.

UNIT I MANAGEMENT OF SUSTAINABILITY 9

Management of sustainability -rationale and political trends: An introduction to sustainability management, International and European policies on sustainable development, theoretical pillars in sustainability management studies.

UNIT II CORPORATE SUSTAINABILITY AND RESPONSIBILITY 9

Corporate sustainability parameter, corporate sustainability institutional framework, integration of sustainability into strategic planning and regular business practices, fundamentals of stakeholder engagement.

UNIT III SUSTAINABILITY MANAGEMENT: STRATEGIES AND APPROACHES 9

Corporate sustainability management and competitiveness: Sustainability-oriented corporate strategies, markets and competitiveness, Green Management between theory and practice, Sustainable Consumption and Green Marketing strategies, Environmental regulation and strategic postures; Green Management approaches and tools; Green engineering: clean technologies and innovation processes; Sustainable Supply Chain Management and Procurement.

UNIT IV SUSTAINABILITY AND INNOVATION 9

Socio-technical transitions and sustainability, Sustainable entrepreneurship, Sustainable pioneers in green market niches, Smart communities and smart specializations.

UNIT V SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS 9

Energy management, Water management, Waste management, Wild Life Conservation, Emerging trends in sustainable management, Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- CO1: An understanding of sustainability management as an approach to aid in evaluating and minimizing environmental impacts while achieving the expected social impact.
- CO2: An understanding of corporate sustainability and responsible Business Practices
- CO3: Knowledge and skills to understand, to measure and interpret sustainability performances.

CO4: Knowledge of innovative practices in sustainable business and community management

CO5: Deep understanding of sustainable management of resources and commodities

REFERENCES:

1. Daddi, T., Iraldo, F., Testa, Environmental Certification for Organizations and Products: Management, 2015
2. Christian N. Madu, Handbook of Sustainability Management 2012
3. Petra Molthan-Hill, The Business Student's Guide to Sustainable Management: Principles and Practice, 2014
4. Margaret Robertson, Sustainability Principles and Practice, 2014
5. Peter Rogers, An Introduction to Sustainable Development, 2006

MAPPING OF POs AND COs:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	1	2	2
CO2	3	2	2	2	1	2
CO3	3	3	1	2	2	3
CO4	3	3	2	1	1	2
CO5	3	3	2	1	2	2

OBA432

MICRO AND SMALL BUSINESS MANAGEMENT

**L T P C
3 0 0 3**

COURSE OBJECTIVES

- To familiarize students with the theory and practice of small business management.
- To learn the legal issues faced by small business and how they impact operations.

UNIT I INTRODUCTION TO SMALL BUSINESS 9

Creation, Innovation, entrepreneurship and small business - Defining Small Business –Role of Owner – Manager – government policy towards small business sector –elements of entrepreneurship – evolution of entrepreneurship –Types of Entrepreneurship – social, civic, corporate - Business life cycle - barriers and triggers to new venture creation – process to assist start ups – small business and family business.

UNIT II SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN 9

Concepts of opportunity recognition; Key factors leading to new venture failure; New venture screening process; Applying new venture screening process to the early stage small firm Role planning in small business – importance of strategy formulation – management skills for small business creation and development.

UNIT III BUILDING THE RIGHT TEAM AND MARKETING STRATEGY 9

Management and Leadership – employee assessments – Tuckman’s stages of group development - The entrepreneurial process model - Delegation and team building - Comparison of HR management in small and large firms - Importance of coaching and how to apply a coaching model.

Marketing within the small business - success strategies for small business marketing - customer delight and business generating systems, - market research, - assessing market performance- sales management and strategy - the marketing mix and marketing strategy.

UNIT IV FINANCING SMALL BUSINESS 9

Main sources of entrepreneurial capital; Nature of 'bootstrap' financing - Difference between cash and profit - Nature of bank financing and equity financing - Funding-equity gap for small firms. Importance of working capital cycle - Calculation of break-even point - Power of gross profit margin- Pricing for profit - Credit policy issues and relating these to cash flow management and profitability.

UNIT V VALUING SMALL BUSINESS AND CRISIS MANAGEMENT 9

Causes of small business failure - Danger signals of impending trouble - Characteristics of poorly performing firms - Turnaround strategies - Concept of business valuation - Different valuation measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying an established small firm - Process of preparing a business for sale.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- CO1. Familiarise the students with the concept of small business
- CO2. In depth knowledge on small business opportunities and challenges
- CO3. Ability to devise plans for small business by building the right skills and marketing strategies
- CO4. Identify the funding source for small start ups
- CO5. Business evaluation for buying and selling of small firms

REFERENCES

1. Hankinson,A.(2000). "The key factors in the profile of small firm owner-managers that influence business performance. The South Coast Small Firms Survey, 1997-2000." Industrial and Commercial Training 32(3):94-98.
2. Parker,R.(2000). "Small is not necessarily beautiful: An evaluation of policy support for small and medium-sized enterprise in Australia." Australian Journal of Political Science 35(2):239-253.
3. Journal articles on SME's.

MAPPING OF POs AND COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	1	-	-
CO2	3	3	3	3	2	3
CO3	3	3	2	2	3	3
CO4	3	2	2	2	1	1
CO5	3	2	2	3	2	1

OBA433

INTELLECTUAL PROPERTY RIGHTS

L T P C

3 0 0 3

COURSE OBJECTIVE

- To understand intellectual property rights and its valuation.

UNIT I INTRODUCTION 9
 Intellectual property rights - Introduction, Basic concepts, Patents, Copyrights, Trademarks, Trade Secrets, Geographic Indicators; Nature of Intellectual Property, Technological Research, Inventions and Innovations, History - the way from WTO to WIPO, TRIPS.

UNIT II PROCESS 9
 New Developments in IPR, Procedure for grant of Patents, TM, GIs, Patenting under Patent Cooperation Treaty, Administration of Patent system in India, Patenting in foreign countries.

UNIT III STATUTES 9
 International Treaties and conventions on IPRs, The TRIPs Agreement, PCT Agreement, The Patent Act of India, Patent Amendment Act (2005), Design Act, Trademark Act, Geographical Indication Act, Bayh-Dole Act and Issues of Academic Entrepreneurship.

UNIT IV STRATEGIES IN INTELLECTUAL PROPERTY 9
 Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies.

UNIT V MODELS 9
 The technologies Know-how, concept of ownership, Significance of IP in Value Creation, IP Valuation and IP Valuation Models, Application of Real Option Model in Strategic Decision Making, Transfer and Licensing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- CO1: Understanding of intellectual property and appreciation of the need to protect it
- CO2: Awareness about the process of patenting
- CO3: Understanding of the statutes related to IPR
- CO4: Ability to apply strategies to protect intellectual property
- CO5: Ability to apply models for making strategic decisions related to IPR

REFERENCES

1. V. Sople Vinod, Managing Intellectual Property by (Prentice hall of India Pvt.Ltd), 2006.
2. Intellectual Property rights and copyrights, EssEss Publications.
3. Primer, R. Anita Rao and Bhanoji Rao, Intellectual Property Rights, Lastain Book company.
4. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2006.
5. WIPO Intellectual Property Hand book.

MAPPING OF POs AND COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	3	2	3

CO2	3	3	2	3	1	3
CO3	3	3	3	3	2	3
CO4	3	3	3	2	1	3
CO5	3	3	3	2	2	3

OBA434

ETHICAL MANAGEMENT

L T P C

3 0 0 3

COURSE OBJECTIVE

- To help students develop knowledge and competence in ethical management and decision making in organizational contexts.

UNIT I ETHICS AND SOCIETY 9

Ethical Management- Definition, Motivation, Advantages-Practical implications of ethical management. Managerial ethics, professional ethics, and social Responsibility-Role of culture and society's expectations- Individual and organizational responsibility to society and the community.

UNIT II ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS 9

Managing in an ethical crisis, the nature of a crisis, ethics in crisis management, discuss case studies, analyze real-world scenarios, develop ethical management skills, knowledge, and competencies. Proactive crisis management.

UNIT III STAKEHOLDERS IN ETHICAL MANAGEMENT 9

Stakeholders in ethical management, identifying internal and external stakeholders, nature of stakeholders, ethical management of various kinds of stakeholders: customers (product and service issues), employees (leadership, fairness, justice, diversity) suppliers, collaborators, business, community, the natural environment (the sustainability imperative, green management, Contemporary issues).

UNIT IV INDIVIDUAL VARIABLES IN ETHICAL MANJAGEMENT 9

Understanding individual variables in ethics, managerial ethics, concepts in ethical psychology- ethical awareness, ethical courage, ethical judgment, ethical foundations, ethical emotions/intuitions/intensity. Utilization of these concepts and competencies for ethical decision-making and management.

UNIT V PRACTICAL FIELD-GUIDE, TECHNIQUES AND SKILLS 9

Ethical management in practice, development of techniques and skills, navigating challenges and dilemmas, resolving issues and preventing unethical management proactively. Role modelling and creating a culture of ethical management and human flourishing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- CO1: Role modelling and influencing the ethical and cultural context.
- CO2: Respond to ethical crises and proactively address potential crises situations.

CO3: Understand and implement stakeholder management decisions.

CO4: Develop the ability, knowledge, and skills for ethical management.

CO5: Develop practical skills to navigate, resolve and thrive in management situations

REFERENCES

1. Brad Agle, Aaron Miller, Bill O' Rourke, The Business Ethics Field Guide: the essential companion to leading your career and your company, 2016.
2. Steiner & Steiner, Business, Government & Society: A managerial Perspective, 2011.
3. Lawrence & Weber, Business and Society: Stakeholders, Ethics, Public Policy, 2020.

MAPPING OF POs AND COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	3	2	3
CO2		3	2	3	1	3
CO3	3	3	3	3	2	3
CO4	3	3	3	2	1	3
CO5	3	3	3	2	2	3

ET4251

IoT FOR SMART SYSTEMS

**LT P C
3 0 0 3**

COURSE OBJECTIVES:

1. To study about **Internet of Things** technologies and its role in real time applications.
2. To introduce the infrastructure required for IoT
3. To familiarize the accessories and communication techniques for IoT.
4. To provide insight about the embedded processor and sensors required for IoT
5. To familiarize the different platforms and Attributes for IoT

UNIT I INTRODUCTION TO INTERNET OF THINGS

9

Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

UNIT II IOT ARCHITECTURE

9

IoT reference model and architecture -Node Structure - Sensing, Processing, Communication, Powering, Networking - Topologies, Layer/Stack architecture, IoT standards, Cloud computing for IoT, Bluetooth, Bluetooth Low Energy beacons.

UNIT III PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT

9

PROTOCOLS:

NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe GSM, CDMA, LTE, GPRS, small cell.

Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.

UNIT IV IOT PROCESSORS

9

Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability.

Embedded processors for IOT : Introduction to Python programming -Building IOT with RASPERRY PI and Arduino.

UNIT V CASE STUDIES

9

Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Analyze the concepts of IoT and its present developments.

CO2: Compare and contrast different platforms and infrastructures available for IoT

CO3: Explain different protocols and communication technologies used in IoT

CO4: Analyze the big data analytic and programming of IoT

CO5: Implement IoT solutions for smart applications

CO	PO					
	1	2	3	4	5	6
1	1	2	1	-	-	-
2	-	2	-	-	-	-
3	1	2	-	1	3	-
4	2		3	3	3	3
5	3	2	3	3	3	3
Avg.	1.75	2	2.33	2.33	3	2

REFERENCES:

1. ArshdeepBahga and VijaiMadiseti : A Hands-on Approach “Internet of Things”,Universities Press 2015.
2. Oliver Hersent , David Boswarthick and Omar Elloumi “ The Internet of Things”, Wiley,2016.
3. Samuel Greengard, “ The Internet of Things”, The MIT press, 2015.
4. Adrian McEwen and Hakim Cassimally“Designing the Internet of Things “Wiley,2014.
5. Jean- Philippe Vasseur, Adam Dunkels, “Interconnecting Smart Objects with IP: The Next Internet” Morgan Kuffmann Publishers, 2010.
6. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, John Wiley and sons, 2014.
7. Lingyang Song/DusitNiyato/ Zhu Han/ Ekram Hossain,” Wireless Device-to-Device Communications and Networks, CAMBRIDGE UNIVERSITY PRESS,2015.
8. OvidiuVermesan and Peter Friess (Editors), “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers Series in Communication, 2013.

9. Vijay Madiseti , ArshdeepBahga, "Internet of Things (A Hands on-Approach)", 2014.
10. Zach Shelby, Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet", John Wiley and sons, 2009.
11. Lars T.Berger and Krzysztof Iniewski, "Smart Grid applications, communications and security", Wiley, 2015.
12. JanakaEkanayake, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama and Nick Jenkins, "Smart Grid Technology and Applications", Wiley, 2015.
13. UpenaDalal,"Wireless Communications & Networks,Oxford,2015.

ET4072

MACHINE LEARNING AND DEEP LEARNING

L T P C
3 0 0 3

COURSE OBJECTIVES:

The course is aimed at

1. Understanding about the learning problem and algorithms
2. Providing insight about neural networks
3. Introducing the machine learning fundamentals and significance
4. Enabling the students to acquire knowledge about pattern recognition.
5. Motivating the students to apply deep learning algorithms for solving real life problems.

UNIT I LEARNING PROBLEMS AND ALGORITHMS

9

Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

UNIT II NEURAL NETWORKS

9

Differences between Biological and Artificial Neural Networks - Typical Architecture, Common Activation Functions, Multi-layer neural network, Linear Separability, Hebb Net, Perceptron, Adaline, Standard Back propagation Training Algorithms for Pattern Association - Hebb rule and Delta rule, Hetero associative, Auto associative, Kohonen Self Organising Maps, Examples of Feature Maps, Learning Vector Quantization, Gradient descent, Boltzmann Machine Learning.

UNIT III MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS

9

Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1- Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

UNIT IV DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS

9

Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

UNIT V DEEP LEARNING: RNNs, AUTOENCODERS AND GANS

9

State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text,

Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs

TOTAL : 45 PERIODS

COURSE OUTCOMES (CO):

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

CO1 : Illustrate the categorization of machine learning algorithms.

CO2: Compare and contrast the types of neural network architectures, activation functions

CO3: Acquaint with the pattern association using neural networks

CO4: Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks

CO5: Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.

CO	PO					
	1	2	3	4	5	6
1	1	3	1	-	-	-
2	2	3	2	-	-	-
3	3	-	3	-	3	-
4	2	3	3	-	-	-
5	3	3	3	-	3	-
6	3	3	3	-	3	-
7	3	3	3	-	3	-
Avg.	2.42	3	2.57	-	3	-

REFERENCES:

1. J. S. R. Jang, C. T. Sun, E. Mizutani, Neuro Fuzzy and Soft Computing - A Computational Approach to Learning and Machine Intelligence, 2012, PHI learning
2. Deep Learning, Ian Good fellow, YoshuaBengio and Aaron Courville, MIT Press, ISBN: 9780262035613, 2016.
3. The Elements of Statistical Learning. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Second Edition. 2009.
4. Pattern Recognition and Machine Learning. Christopher Bishop. Springer. 2006.
5. Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017.

PX4012

RENEWABLE ENERGY TECHNOLOGY

L T P C

3 0 0 3

OBJECTIVES:

To impart knowledge on

- Different types of renewable energy technologies
- Standalone operation, grid connected operation of renewable energy systems

UNIT I INTRODUCTION

9

Classification of energy sources – Co2 Emission - Features of Renewable energy - Renewable energy scenario in India -Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption - CO₂ Emission - importance of renewable energy sources, Potentials – Achievements– Applications.

UNIT II SOLAR PHOTOVOLTAICS

9

Solar Energy: Sun and Earth-Basic Characteristics of solar radiation- angle of sunrays on solar collector-Estimating Solar Radiation Empirically - Equivalent circuit of PV Cell- Photovoltaic cell-characteristics: P-V and I-V curve of cell-Impact of Temperature and Insolation on I-V characteristics-Shading Impacts on I-V characteristics-Bypass diode -Blocking diode.

UNIT III PHOTOVOLTAIC SYSTEM DESIGN 9

Block diagram of solar photo voltaic system : Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

UNIT IV WIND ENERGY CONVERSION SYSTEMS 9

Origin of Winds: Global and Local Winds- Aerodynamics of Wind turbine-Derivation of Betz’s limit-Power available in wind-Classification of wind turbine: Horizontal Axis wind turbine and Vertical axis wind turbine- Aerodynamic Efficiency-Tip Speed-Tip Speed Ratio-Solidity-Blade Count-Power curve of wind turbine - Configurations of wind energy conversion systems: Type A, Type B, Type C and Type D Configurations- Grid connection Issues - Grid integrated SCIG and PMSG based WECS.

UNIT V OTHER RENEWABLE ENERGY SOURCES 9

Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geothermal Energy Resources.

TOTAL : 45 PERIODS

OUTCOMES:

After completion of this course, the student will be able to:

- CO1: Demonstrate the need for renewable energy sources.
- CO2: Develop a stand-alone photo voltaic system and implement a maximum power point tracking in the PV system.
- CO3: Design a stand-alone and Grid connected PV system.
- CO4: Analyze the different configurations of the wind energy conversion systems.
- CO5: Realize the basic of various available renewable energy sources

REFERENCES:

1. S.N.Bhadra, D. Kastha, & S. Banerjee “Wind Electrical Systems”, Oxford University Press, 2009.
2. Rai. G.D, “Non conventional energy sources”, Khanna publishes, 1993.
3. Rai. G.D,” Solar energy utilization”, Khanna publishes, 1993.
4. Chetan Singh Solanki, “Solar Photovoltaics: Fundamentals, Technologies and Applications”, PHI Learning Private Limited, 2012.
5. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006
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7. B.H.Khan, " Non-conventional Energy sources", , McGraw-hill, 2nd Edition, 2009.
8. Fang Lin Luo Hong Ye, " Renewable Energy systems", Taylor & Francis Group,2013.

CO-PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		2	2	2	1
CO2	3		2	3	3	3

CO3	3		2	3	3	3
CO4	3		2	3	3	2
CO5	3		2	2	2	2

PS4093

SMART GRID

L T P C
3 0 0 3

COURSE OBJECTIVES

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To know about the function of smart grid.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications
- To get familiarized with the communication networks for Smart Grid applications

UNIT I INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study.

UNIT II SMART GRID TECHNOLOGIES 9

Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.



UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU) & their application for monitoring & protection. Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Unit V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

Architecture and Standards -Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.

TOTAL : 45 PERIODS

COURSE OUTCOME:

Students able to

CO1: Relate with the smart resources, smart meters and other smart devices.

CO2: Explain the function of Smart Grid.

CO3: Experiment the issues of Power Quality in Smart Grid.

CO4: Analyze the performance of Smart Grid.

CO5: Recommend suitable communication networks for smart grid applications

REFERENCES

1. Stuart Borlase 'Smart Grid: Infrastructure, Technology and Solutions', CRC Press 2012.
2. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, 'Smart Grid: Technology and Applications', Wiley, 2012.
3. Mini S. Thomas, John D McDonald, 'Power System SCADA and Smart Grids', CRC Press, 2015
4. Kenneth C.Budka, Jayant G. Deshpande, Marina Thottan, 'Communication Networks for Smart Grids', Springer, 2014
5. SMART GRID Fundamentals of Design and Analysis, James Momoh, IEEE press, A John Wiley & Sons, Inc., Publication.

MAPPING OF CO'S WITH PO'S

CO	PO					
	1	2	3	4	5	6
1	3	2	-	2	2	2
2	3	-	2	2	-	2
3	2	-	1	-	-	-
4	1	-	-	3	3	1
5	-	2	2	2	2	3
AVG	2.25	2	1.66	2.25	2.3	2

CP4391

SECURITY PRACTICES

L T P C

3 0 0 3

COURSE OBJECTIVES:

- To learn the core fundamentals of system and web security concepts
- To have through understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and cloud security
- To perform a detailed study of Privacy and Storage security and related Issues

UNIT I SYSTEM SECURITY

9

Model of network security – Security attacks, services and mechanisms – OSI security architecture -A Cryptography primer- Intrusion detection system- Intrusion Prevention system - Security web applications- Case study: OWASP - Top 10 Web Application Security Risks.

UNIT II NETWORK SECURITY

9

Internet Security - Intranet security- Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security - Mobile security - IOT security - Case Study - Kali Linux.

UNIT III SECURITY MANAGEMENT 9
 Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and User Management System. Case study: Metasploit

UNIT IV CYBER SECURITY AND CLOUD SECURITY 9
 Cyber Forensics- Disk Forensics – Network Forensics – Wireless Forensics – Database Forensics – Malware Forensics – Mobile Forensics – Email Forensics- Best security practices for automate Cloud infrastructure management – Establishing trust in IaaS, PaaS, and SaaS Cloud types. Case study: DVWA

UNIT V PRIVACY AND STORAGE SECURITY 9
 Privacy on the Internet - Privacy Enhancing Technologies - Personal privacy Policies - Detection of Conflicts in security policies- privacy and security in environment monitoring systems. Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- CO1:** Understand the core fundamentals of system security
- CO2:** Apply the security concepts to wired and wireless networks
- CO3:** Implement and Manage the security essentials in IT Sector
- CO4:** Explain the concepts of Cyber Security and Cyber forensics
- CO5:** Be aware of Privacy and Storage security Issues.

REFERENCES

1. John R. Vacca, Computer and Information Security Handbook, Third Edition, Elsevier 2017
2. Michael E. Whitman, Herbert J. Mattord, Principles of Information Security, Seventh Edition, Cengage Learning, 2022
3. Richard E. Smith, Elementary Information Security, Third Edition, Jones and Bartlett Learning, 2019
4. Mayor, K.K.Mookhey, Jacopo Cervini, Fairuzan Roslan, Kevin Beaver, Metasploit Toolkit for Penetration Testing, Exploit Development and Vulnerability Research, Syngress publications, Elsevier, 2007. ISBN : 978-1-59749-074-0
5. John Sammons, "The Basics of Digital Forensics- The Primer for Getting Started in Digital Forensics", Syngress, 2012
6. Cory Altheide and Harlan Carvey, "Digital Forensics with Open Source Tools", 2011 Syngress, ISBN: 9781597495875.
7. Siani Pearson, George Yee "Privacy and Security for Cloud Computing" Computer Communications and Networks, Springer, 2013.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	2	1	1	2	1
2	2	1	3	1	1	2
3			2	3	3	3
4	2	2	1	2	1	3
5	1		1	1	2	3
Avg	1.50	1.67	1.60	1.60	1.80	2.40

COURSE OBJECTIVES:

- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution
- To understand the architecture, infrastructure and delivery models of cloud computing.
- To explore the roster of AWS services and illustrate the way to make applications in AWS
- To gain knowledge in the working of Windows Azure and Storage services offered by Windows Azure
- To develop the cloud application using various programming model of Hadoop and Aneka

UNIT I VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE 6

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines –Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization –Management Virtualization — Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization- Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation

UNIT II CLOUD PLATFORM ARCHITECTURE 12

Cloud Computing: Definition, Characteristics - Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Architectural Design Challenges

UNIT III AWS CLOUD PLATFORM - IAAS 9

Amazon Web Services: AWS Infrastructure- AWS API- AWS Management Console - Setting up AWS Storage - Stretching out with Elastic Compute Cloud - Elastic Container Service for Kubernetes- AWS Developer Tools: AWS Code Commit, AWS Code Build, AWS Code Deploy, AWS Code Pipeline, AWS code Star - AWS Management Tools: Cloud Watch, AWS Auto Scaling, AWS control Tower, Cloud Formation, Cloud Trail, AWS License Manager

UNIT IV PAAS CLOUD PLATFORM 9

Windows Azure: Origin of Windows Azure, Features, The Fabric Controller – First Cloud APP in Windows Azure- Service Model and Managing Services: Definition and Configuration, Service runtime API- Windows Azure Developer Portal- Service Management API- Windows Azure Storage Characteristics-Storage Services- REST API- Blops

UNIT V PROGRAMMING MODEL 9

Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

- CO1:** Employ the concepts of virtualization in the cloud computing
CO2: Identify the architecture, infrastructure and delivery models of cloud computing
CO3: Develop the Cloud Application in AWS platform
CO4: Apply the concepts of Windows Azure to design Cloud Application
CO5: Develop services using various Cloud computing programming models.

REFERENCES

1. Bernard Golden, Amazon Web Service for Dummies, John Wiley & Sons, 2013.

2. Raoul Alongi, AWS: The Most Complete Guide to Amazon Web Service from Beginner to Advanced Level, Amazon Asia- Pacific Holdings Private Limited, 2019.
3. Sriram Krishnan, Programming: Windows Azure, O'Reilly, 2010.
4. Rajkumar Buyya, Christian Vacchiola, S.Thamarai Selvi, Mastering Cloud Computing , McGraw Hill Education (India) Pvt. Ltd., 2013.
5. Danielle Ruest, Nelson Ruest, —Virtualization: A Beginner's Guidell, McGraw-Hill Osborne Media, 2009.
6. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
7. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
8. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
9. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

IF4072

DESIGN THINKING

**L T P C
3 0 0 3**

COURSE OBJECTIVES:

- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- Research Methods used in Design
- Tools used in UI & UX
- Creating a wireframe and prototype

UNIT I

UX LIFECYCLE TEMPLATE

8

Introduction. A UX process lifecycle template. Choosing a process instance for your project. The system complexity space. Meet the user interface team. Scope of UX presence within the team. More about UX lifecycles. Business Strategy. Value Innovation. Validated User Research. Killer UX Design. The Blockbuster Value Proposition. What Is a Value Proposition?.

UNIT II

CONTEXTUAL INQUIRY

10

The system concept statement. User work activity data gathering. Look for emotional aspects of work practice. Abridged contextual inquiry process. Data-driven vs. model-driven inquiry. Organizing concepts: work roles and flow model. Creating and managing work activity notes. Constructing your work activity affinity diagram (WAAD). Abridged contextual analysis process. History of affinity diagrams.

UNIT III

DESIGN THINKING, IDEATION, AND SKETCHING

9

Design-informing models: second span of the bridge . Some general "how to" suggestions. A New example domain: slideshow presentations. User models. Usage models. Work environment models. Barrier summaries. Model consolidation. Protecting your sources. Abridged methods for design-informing models extraction. Design paradigms. Design thinking. Design perspectives. User personas. Ideation. Sketching

UNIT IV

UX GOALS, METRICS, AND TARGETS

8

Introduction. UX goals. UX target tables. Work roles, user classes, and UX goals. UX measures.

Measuring instruments. UX metrics. Baseline level. Target level. Setting levels. Observed results. Practical tips and cautions for creating UX targets. How UX targets help manage the user experience engineering process.

UNIT V ANALYSING USER EXPERIENCE

10

Sharpening Your Thinking Tools. UX Research and Strength of Evidence. Agile Personas. How to Prioritize Usability Problems. Creating Insights, Hypotheses and Testable Design Ideas. How to Manage Design Projects with User Experience Metrics. Two Measures that Will Justify Any Design Change. Evangelizing UX Research. How to Create a User Journey Map. Generating Solutions to Usability Problems. Building UX Research Into the Design Studio Methodology. Dealing with Common objections to UX Research. The User Experience Debrief Meeting. Creating a User Experience Dashboard.

SUGGESTED ACTIVITIES:

- 1: Hands on Design Thinking process for a product
- 2: Defining the Look and Feel of any new Project
- 3: Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
- 4: Identify a customer problem to solve.
- 5: Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- CO1:** Build UI for user Applications
- CO2:** Use the UI Interaction behaviors and principles
- CO3:** Evaluate UX design of any product or application
- CO4:** Demonstrate UX Skills in product development
- CO5:** Implement Sketching principles

REFERENCES

1. UX for Developers: How to Integrate User-Centered Design Principles Into Your Day-to-Day Development Work, Westley Knight. Apress, 2018
2. The UX Book: Process and Guidelines for Ensuring a Quality User Experience, Rex Hartson, Pardha Pyla. Morgan Kaufmann, 2012
3. UX Fundamentals for Non-UX Professionals: User Experience Principles for Managers, Writers, Designers, and Developers, Edward Stull. Apress, 2018
4. Lean UX: Designing Great Products with Agile Teams, Gothelf, Jeff, Seiden, and Josh. O'Reilly Media, 2016
5. Designing UX: Prototyping: Because Modern Design is Never Static, Ben Coleman, and Dan Goodwin. SitePoint, 2017

MU4153

PRINCIPLES OF MULTIMEDIA

L T P C

3 0 0 3

COURSE OBJECTIVES:

- To get familiarity with gamut of multimedia and its significance
- To acquire knowledge in multimedia components.
- To acquire knowledge about multimedia tools and authoring.
- To acquire knowledge in the development of multimedia applications.

- To explore the latest trends and technologies in multimedia

UNIT I INTRODUCTION

9

Introduction to Multimedia – Characteristics of Multimedia Presentation – Multimedia Components – Promotion of Multimedia Based Components – Digital Representation – Media and Data Streams – Multimedia Architecture – Multimedia Documents, Multimedia Tasks and Concerns, Production, sharing and distribution, Hypermedia, WWW and Internet, Authoring, Multimedia over wireless and mobile networks.

Suggested Activities:

1. Flipped classroom on media Components.
2. External learning – Interactive presentation.

Suggested Evaluation Methods:

1. Tutorial – Handling media components
2. Quizzes on different types of data presentation.

UNIT II ELEMENTS OF MULTIMEDIA

9

Text-Types, Font, Unicode Standard, File Formats, Graphics and Image data representations – data types, file formats, color models; video – color models in video, analog video, digital video, file formats, video display interfaces, 3D video and TV: Audio – Digitization, SNR, SQNR, quantization, audio quality, file formats, MIDI; Animation- Key Frames and Tweening, other Techniques, 2D and 3D Animation.

Suggested Activities:

1. Flipped classroom on different file formats of various media elements.
2. External learning – Adobe after effects, Adobe Media Encoder, Adobe Audition.

Suggested Evaluation Methods:

1. Demonstration on after effects animations.
2. Quizzes on file formats and color models.

UNIT III MULTIMEDIA TOOLS

9

Authoring Tools – Features and Types – Card and Page Based Tools – Icon and Object Based Tools – Time Based Tools – Cross Platform Authoring Tools – Editing Tools – Painting and Drawing Tools – 3D Modeling and Animation Tools – Image Editing Tools – Sound Editing Tools – Digital Movie Tools.

Suggested Activities:

1. Flipped classroom on multimedia tools.
2. External learning – Comparison of various authoring tools.

Suggested Evaluation Methods:

1. Tutorial – Audio editing tool.
2. Quizzes on animation tools.

UNIT IV MULTIMEDIA SYSTEMS

9

Compression Types and Techniques: CODEC, Text Compression: GIF Coding Standards, JPEG standard – JPEG 2000, basic audio compression – ADPCM, MPEG Psychoacoustics, basic Video compression techniques – MPEG, H.26X – Multimedia Database System – User Interfaces – OS Multimedia Support – Hardware Support – Real Time Protocols – Play Back Architectures – Synchronization – Document Architecture – Hypermedia Concepts: Hypermedia Design – Digital Copyrights, Content analysis.

Suggested Activities:

1. Flipped classroom on concepts of multimedia hardware architectures.
2. External learning – Digital repositories and hypermedia design.

Suggested Evaluation Methods:

1. Quizzes on multimedia hardware and compression techniques.
2. Tutorial – Hypermedia design.

UNIT V MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS 9

ADDIE Model – Conceptualization – Content Collection – Storyboard–Script Authoring Metaphors – Testing – Report Writing – Documentation. Multimedia for the web and mobile platforms. Virtual Reality, Internet multimedia content distribution, Multimedia Information sharing – social media sharing, cloud computing for multimedia services, interactive cloud gaming. Multimedia information retrieval.

Suggested Activities:

1. External learning – Game consoles.
2. External learning – VRML scripting languages.

Suggested Evaluation Methods:

1. Demonstration of simple interactive games.
2. Tutorial – Simple VRML program.

TOTAL : 45 PERIODS**COURSE OUTCOMES:****CO1:**Handle the multimedia elements effectively.**CO2:**Articulate the concepts and techniques used in multimedia applications.**CO3:**Develop effective strategies to deliver Quality of Experience in multimedia applications.**CO4:**Design and implement algorithms and techniques applied to multimedia objects.**CO5:**Design and develop multimedia applications following software engineering models.**REFERENCES:**

1. Li, Ze-Nian, Drew, Mark, Liu, Jiangchuan, “Fundamentals of Multimedia”, Springer, Third Edition, 2021.
2. Prabhat K.Andleigh, Kiran Thakrar, “MULTIMEDIA SYSTEMS DESIGN”, Pearson Education, 2015.
3. Gerald Friedland, Ramesh Jain, “Multimedia Computing”, Cambridge University Press, 2018. (digital book)
4. Ranjan Parekh, “Principles of Multimedia”, Second Edition, McGraw-Hill Education, 2017

DS4015**BIG DATA ANALYTICS****L T P C
3 0 0 3****COURSE OBJECTIVES:**

- To understand the basics of big data analytics
- To understand the search methods and visualization
- To learn mining data streams
- To learn frameworks
- To gain knowledge on R language

UNIT I INTRODUCTION TO BIG DATA**9**

Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis Vs Reporting - Modern Data Analytic Tools- Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.

UNIT II SEARCH METHODS AND VISUALIZATION 9

Search by simulated Annealing – Stochastic, Adaptive search by Evaluation – Evaluation Strategies – Genetic Algorithm – Genetic Programming – Visualization – Classification of Visual Data Analysis Techniques – Data Types – Visualization Techniques – Interaction techniques – Specific Visual data analysis Techniques

UNIT III MINING DATA STREAMS 9

Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions

UNIT IV FRAMEWORKS 9

MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Case Study- Preventing Private Information Inference Attacks on Social Networks- Grand Challenge: Applying Regulatory Science and Big Data to Improve Medical Device Innovation

UNIT V R LANGUAGE 9

Overview, Programming structures: Control statements -Operators -Functions -Environment and scope issues -Recursion -Replacement functions, R data structures: Vectors -Matrices and arrays - Lists -Data frames -Classes, Input/output, String manipulations

COURSE OUTCOMES:

CO1: understand the basics of big data analytics

CO2: Ability to use Hadoop, Map Reduce Framework.

CO3: Ability to identify the areas for applying big data analytics for increasing the business outcome.

CO4: gain knowledge on R language

CO5: Contextually integrate and correlate large amounts of information to gain faster insights.

TOTAL:45 PERIODS

REFERENCE:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 3rd edition 2020.
3. Norman Matloff, The Art of R Programming: A Tour of Statistical Software Design, No Starch Press, USA, 2011.
4. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & sons, 2012.
5. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	3	3	3	3	2	1
2	3	3	3	3	2	1
3	3	3	3	3	2	1
4	3	3	3	3	2	1
5	3	3	3	3	2	1
Avg	3	3	3	3	2	1

COURSE OBJECTIVES:

- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

UNIT I FUNDAMENTALS OF IoT**9**

Introduction to IoT – IoT definition – Characteristics – IoT Complete Architectural Stack – IoT enabling Technologies – IoT Challenges. Sensors and Hardware for IoT – Hardware Platforms – Arduino, Raspberry Pi, Node MCU. A Case study with any one of the boards and data acquisition from sensors.

UNIT II PROTOCOLS FOR IoT**9**

Infrastructure protocol (IPV4/V6/RPL), Identification (URIs), Transport (Wifi, Lifi, BLE), Discovery, Data Protocols, Device Management Protocols. – A Case Study with MQTT/CoAP usage-IoT privacy, security and vulnerability solutions.

UNIT III CASE STUDIES/INDUSTRIAL APPLICATIONS**9**

Case studies with architectural analysis: IoT applications – Smart City – Smart Water – Smart Agriculture – Smart Energy – Smart Healthcare – Smart Transportation – Smart Retail – Smart waste management.

UNIT IV CLOUD COMPUTING INTRODUCTION**9**

Introduction to Cloud Computing - Service Model – Deployment Model- Virtualization Concepts – Cloud Platforms – Amazon AWS – Microsoft Azure – Google APIs.

UNIT V IoT AND CLOUD**9**

IoT and the Cloud - Role of Cloud Computing in IoT - AWS Components - S3 – Lambda - AWS IoT Core -Connecting a web application to AWS IoT using MQTT- AWS IoT Examples. Security Concerns, Risk Issues, and Legal Aspects of Cloud Computing- Cloud Data Security

TOTAL:45 PERIODS**COURSE OUTCOMES:**

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

CO1: Understand the various concept of the IoT and their technologies..

CO2: Develop IoT application using different hardware platforms

CO3: Implement the various IoT Protocols

CO4: Understand the basic principles of cloud computing.

CO5: Develop and deploy the IoT application into cloud environment

REFERENCES

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman ,CRC Press, 2017
2. Adrian McEwen, Designing the Internet of Things, Wiley,2013.

3. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.
4. Simon Walkowiak, "Big Data Analytics with R" PackT Publishers, 2016
5. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.

MX4073

MEDICAL ROBOTICS

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To explain the basic concepts of robots and types of robots
- To discuss the designing procedure of manipulators, actuators and grippers
- To impart knowledge on various types of sensors and power sources
- To explore various applications of Robots in Medicine
- To impart knowledge on wearable robots

UNIT I INTRODUCTION TO ROBOTICS 9

Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization

Sensors and Actuators

Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models

UNIT II MANIPULATORS & BASIC KINEMATICS 9

Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems

Navigation and Treatment Planning

Variable speed arrangements, Path determination – Machinery vision, Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor

UNIT III SURGICAL ROBOTS 9

Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump, CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, General Surgery and Nanorobotics. Case Study

UNIT IV REHABILITATION AND ASSISTIVE ROBOTS 9

Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking, Clinical-Based Gait Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replication. Portable Robot for Tele rehabilitation, Robotic Exoskeletons – Design considerations, Hybrid assistive limb. Case Study

UNIT V WEARABLE ROBOTS 9

Augmented Reality, Kinematics and Dynamics for Wearable Robots, Wearable Robot technology, Sensors, Actuators, Portable Energy Storage, Human–robot cognitive interaction (cHRI), Human–robot physical interaction (pHRI), Wearable Robotic Communication - case study

TOTAL:45 PERIODS

COURSE OUTCOMES:

- CO1:** Describe the configuration, applications of robots and the concept of grippers and actuators
CO2: Explain the functions of manipulators and basic kinematics

- CO3:** Describe the application of robots in various surgeries
CO4: Design and analyze the robotic systems for rehabilitation
CO5: Design the wearable robots

REFERENCES

1. Nagrath and Mittal, "Robotics and Control", Tata McGraw Hill, First edition, 2003
2. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and Sons, First edition, 2008
3. Fu.K.S, Gonzalez. R.C., Lee, C.S.G, "Robotics, control", sensing, Vision and Intelligence, Tata McGraw Hill International, First edition, 2008
4. Bruno Siciliano, Oussama Khatib, Springer Handbook of Robotics, 1st Edition, Springer, 2008
5. Shane (S.Q.) Xie, Advanced Robotics for Medical Rehabilitation - Current State of the Art and Recent Advances, Springer, 2016
6. Sashi S Kommu, Rehabilitation Robotics, I-Tech Education and Publishing, 2007
7. Jose L. Pons, Wearable Robots: Biomechatronic Exoskeletons, John Wiley & Sons Ltd, England, 2008
8. Howie Choset, Kevin Lynch, Seth Hutchinson, "Principles of Robot Motion: Theory, Algorithms, and Implementations", Prentice Hall of India, First edition, 2005
9. Philippe Coiffet, Michel Chirouze, "An Introduction to Robot Technology", Tata McGraw Hill, First Edition, 1983
10. Jacob Rosen, Blake Hannaford & Richard M Satava, "Surgical Robotics: System Applications & Visions", Springer 2011
11. Jocelyn Troccaz, Medical Robotics, Wiley, 2012
12. Achim Schweikard, Floris Ernst, Medical Robotics, Springer, 2015

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1				1		
2				2		
3	2		2	2	2	2
4	2		2	2	3	2
5	2		2	2	3	3
Avg	2		2	1.8	2.6	2.3

VE4202

EMBEDDED AUTOMATION

L T P C

3 0 0 3

COURSE OBJECTIVES:

- To learn about the process involved in the design and development of real-time embedded system
- To develop the embedded C programming skills on 8-bit microcontroller
- To study about the interfacing mechanism of peripheral devices with 8-bit microcontrollers
- To learn about the tools, firmware related to microcontroller programming
- To build a home automation system

UNIT - I INTRODUCTION TO EMBEDDED C PROGRAMMING

9

C Overview and Program Structure - C Types, Operators and Expressions - C Control Flow - C Functions and Program Structures - C Pointers And Arrays - FIFO and LIFO - C Structures - Development Tools

UNIT - II AVR MICROCONTROLLER**9**

ATMEGA 16 Architecture - Nonvolatile and Data Memories - Port System - Peripheral Features : Time Base, Timing Subsystem, Pulse Width Modulation, USART, SPI, Two Wire Serial Interface, ADC, Interrupts - Physical and Operating Parameters

UNIT – III HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES CONTROLLERS**9**

Lights and Switches - Stack Operation - Implementing Combinational Logic - Expanding I/O - Interfacing Analog To Digital Convertors - Interfacing Digital To Analog Convertors - LED Displays : Seven Segment Displays, Dot Matrix Displays - LCD Displays - Driving Relays - Stepper Motor Interface - Serial EEPROM - Real Time Clock - Accessing Constants Table - Arbitrary Waveform Generation - Communication Links - System Development Tools

UNIT – IV VISION SYSTEM**9**

Fundamentals of Image Processing - Filtering - Morphological Operations - Feature Detection and Matching - Blurring and Sharpening - Segmentation - Thresholding - Contours - Advanced Contour Properties - Gradient - Canny Edge Detector - Object Detection - Background Subtraction

UNIT – V HOME AUTOMATION**9**

Home Automation - Requirements - Water Level Notifier - Electric Guard Dog - Tweeting Bird Feeder - Package Delivery Detector - Web Enabled Light Switch - Curtain Automation - Android Door Lock - Voice Controlled Home Automation - Smart Lighting - Smart Mailbox - Electricity Usage Monitor - Proximity Garage Door Opener - Vision Based Authentic Entry System

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

On successful completion of this course, students will be able to

CO1: analyze the 8-bit series microcontroller architecture, features and pin details

CO2: write embedded C programs for embedded system application

CO3: design and develop real time systems using AVR microcontrollers

CO4: design and develop the systems based on vision mechanism

CO5: design and develop a real time home automation system

REFERENCES:

1. Dhananjay V. Gadre, "Programming and Customizing the AVR Microcontroller", McGraw-Hill, 2001.
2. Joe Pardue, "C Programming for Microcontrollers ", Smiley Micros, 2005.
3. Steven F. Barrett, Daniel J. Pack, "ATMEL AVR Microcontroller Primer : Programming and Interfacing", Morgan & Claypool Publishers, 2012
4. Mike Riley, "Programming Your Home - Automate With Arduino, Android and Your Computer", the Pragmatic Programmers, Llc, 2012.
5. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011.
6. Kevin P. Murphy, "Machine Learning - a Probabilistic Perspective", the MIT Press Cambridge, Massachusetts, London, 2012.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	<u>1</u>		<u>1</u>	<u>1</u>	<u>1</u>	
2	<u>1</u>	3	<u>1</u>	<u>1</u>	<u>1</u>	3
3	<u>1</u>	3	<u>1</u>	<u>1</u>	<u>1</u>	3
4	<u>1</u>	3	<u>1</u>	<u>1</u>	<u>1</u>	3

5	<u>1</u>	3	<u>1</u>	<u>1</u>	<u>1</u>	3
Avg	<u>(5/5)=1</u>	(12/4)=3	<u>(5/5)=1</u>	<u>(5/5)=1</u>	<u>(5/5)=1</u>	(12/4)=3

CX4016	ENVIRONMENTAL SUSTAINABILITY	L	T	P	C
		3	0	0	3
UNIT I	INTRODUCTION				9
Valuing the Environment: Concepts, Valuing the Environment: Methods, Property Rights, Externalities, and Environmental Problems					
UNIT II	CONCEPT OF SUSTAINABILITY				9
Sustainable Development: Defining the Concept, the Population Problem, Natural Resource Economics: An Overview, Energy, Water, Agriculture					
UNIT III	SIGNIFICANCE OF BIODIVERSITY				9
Biodiversity, Forest Habitat, Commercially Valuable Species, Stationary - Source Local Air Pollution, Acid Rain and Atmospheric Modification, Transportation					
UNIT IV	POLLUTION IMPACTS				9
Water Pollution, Solid Waste and Recycling, Toxic Substances and Hazardous Wastes, Global Warming.					
UNIT V	ENVIRONMENTAL ECONOMICS				9
Development, Poverty, and the Environment, Visions of the Future, Environmental economics and policy by Tom Tietenberg, Environmental Economics					
					TOTAL : 45 PERIODS

REFERENCES

1. Andrew Hoffman, Competitive Environmental Strategy - A Guide for the Changing Business Landscape, Island Press.
2. Stephen Doven, Environment and Sustainability Policy: Creation, Implementation, Evaluation, the Federation Press, 2005
3. Robert Brinkmann., Introduction to Sustainability, Wiley-Blackwell., 2016
4. Niko Roorda., Fundamentals of Sustainable Development, 3rd Edn, Routledge, 2020
5. Bhavik R Bakshi., Sustainable Engineering: Principles and Practice, Cambridge University Press, 2019

TX4092	TEXTILE REINFORCED COMPOSITES	L	T	P	C
		3	0	0	3

UNIT I	REINFORCEMENTS	9
Introduction – composites –classification and application; reinforcements- fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites		

UNIT II MATRICES **9**
Preparation, chemistry, properties and applications of thermoplastic and thermoset resins; mechanism of interaction of matrices and reinforcements; optimization of matrices

UNIT III COMPOSITE MANUFACTURING **9**
Classification; methods of composites manufacturing for both thermoplastics and thermosets- Hand layup, Filament Winding, Resin transfer moulding, prepregs and autoclave moulding, pultrusion, vacuum impregnation methods, compression moulding; post processing of composites and composite design requirements

UNIT IV TESTING **9**
Fibre volume and weight fraction, specific gravity of composites, tensile, flexural, impact, compression, inter laminar shear stress and fatigue properties of thermoset and thermoplastic composites.

UNIT V MECHANICS **9**
Micro mechanics, macro mechanics of single layer, macro mechanics of laminate, classical lamination theory, failure theories and prediction of inter laminar stresses using at ware

TOTAL: 45 PERIODS

REFERENCES

1. BorZ.Jang, "Advanced Polymer composites", ASM International, USA, 1994.
2. Carlsson L.A. and Pipes R.B., "Experimental Characterization of advanced composite Materials", Second Edition, CRC Press, New Jersey, 1996.
3. George Lubin and Stanley T. Peters, "Handbook of Composites", Springer Publications, 1998.
4. Mel. M. Schwartz, "Composite Materials", Vol. 1 & 2, Prentice Hall PTR, New Jersey, 1997.
5. Richard M. Christensen, "Mechanics of composite materials", Dover Publications, 2005.
6. Sanjay K. Mazumdar, "Composites Manufacturing: Materials, Product, and Process Engineering", CRC Press, 2001

NT4002

NANOCOMPOSITE MATERIALS

L T P C
3 0 0 3

UNIT I BASICS OF NANOCOMPOSITES **9**
Nomenclature, Properties, features and processing of nanocomposites. Sample Preparation and Characterization of Structure and Physical properties. Designing, stability and mechanical properties and applications of super hard nanocomposites.

UNIT II METAL BASED NANOCOMPOSITES **9**
Metal-metal nanocomposites, some simple preparation techniques and their properties. Metal- Oxide or Metal-Ceramic composites, Different aspects of their preparation techniques and their final properties and functionality. Fractal based glass-metal nanocomposites, its designing and fractal dimension analysis. Core-Shell structured nanocomposites

UNIT III POLYMER BASED NANOCOMPOSITES **9**
Preparation and characterization of diblock Copolymer based nanocomposites; Polymer Carbon

nanotubes based composites, their mechanical properties, and industrial possibilities.

UNIT IV NANOCOMPOSITE FROM BIOMATERIALS

9

Natural nanocomposite systems - spider silk, bones, shells; organic-inorganic nanocomposite formation through self-assembly. Biomimetic synthesis of nanocomposites material; Use of synthetic nanocomposites for bone, teeth replacement.

UNIT V NANOCOMPOSITE TECHNOLOGY

9

Nanocomposite membrane structures- Preparation and applications. Nanotechnology in Textiles and Cosmetics-Nano-fillers embedded polypropylene fibers – Soil repellence, Lotus effect - Nano finishing in textiles (UV resistant, anti-bacterial, hydrophilic, self-cleaning, flame retardant finishes), Sun-screen dispersions for UV protection using titanium oxide – Colour cosmetics. Nanotechnology in Food Technology - Nanopackaging for enhanced shelf life - Smart/Intelligent packaging.

TOTAL : 45 PERIODS

REFERENCES:

1. Introduction to Nanocomposite Materials. Properties, Processing, Characterization- Thomas E. Twardowski. 2007. DEStech Publications. USA.
2. Nanocomposites Science and Technology - P. M. Ajayan, L.S. Schadler, P. V. Braun 2006.
3. Physical Properties of Carbon Nanotubes- R. Saito 1998.
4. Carbon Nanotubes (Carbon , Vol 33) - M. Endo, S. Iijima, M.S. Dresselhaus 1997.
5. The search for novel, superhard materials- Stan Veprjek (Review Article) JVST A, 1999
6. Nanometer versus micrometer-sized particles-Christian Brosseau, Jamal BeN Youssef, Philippe Talbot, Anne-Marie Konn, (Review Article) J. Appl. Phys, Vol 93, 2003
7. Diblock Copolymer, - Aviram (Review Article), Nature, 2002
8. Bikramjit Basu, Kantesh Balani Advanced Structural Ceramics, A John Wiley & Sons, Inc.,
9. P. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead publication, London, 2006

BY4016

IPR, BIOSAFETY AND ENTREPRENEURSHIP

LT PC

3 0 0 3

UNIT I IPR

9

Intellectual property rights – Origin of the patent regime – Early patents act & Indian pharmaceutical industry – Types of patents – Patent Requirements – Application preparation filing and prosecution – Patentable subject matter – Industrial design, Protection of GMO's IP as a factor in R&D, IP's of relevance to biotechnology and few case studies.

UNIT II AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES

9

History of GATT Agreement – Madrid Agreement – Hague Agreement – WIPO Treaties – Budapest Treaty – PCT – Ordinary – PCT – Conventional – Divisional and Patent of Addition – Specifications – Provisional and complete – Forms and fees Invention in context of “prior art” – Patent databases – Searching International Databases – Country-wise patent searches (USPTO, espacenet(EPO) – PATENT Scope (WIPO) – IPO, etc National & PCT filing procedure – Time frame and cost – Status of the patent applications filed – Precautions while patenting –

disclosure/non-disclosure – Financial assistance for patenting – Introduction to existing schemes
Patent licensing and agreement Patent infringement – Meaning, scope, litigation, case studies

UNIT III BIOSAFETY 9

Introduction – Historical Background – Introduction to Biological Safety Cabinets – Primary Containment for Biohazards – Biosafety Levels – Biosafety Levels of Specific Microorganisms – Recommended Biosafety Levels for Infectious Agents and Infected Animals – Biosafety guidelines – Government of India.

UNIT IV GENETICALLY MODIFIED ORGANISMS 9

Definition of GMOs & LMOs – Roles of Institutional Biosafety Committee – RCGM – GEAC etc. for GMO applications in food and agriculture – Environmental release of GMOs – Risk Analysis – Risk Assessment – Risk management and communication – Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

UNIT V ENTREPRENEURSHIP DEVELOPMENT 9

Introduction – Entrepreneurship Concept – Entrepreneurship as a career – Entrepreneurial personality – Characteristics of successful Entrepreneur – Factors affecting entrepreneurial growth – Entrepreneurial Motivation – Competencies – Mobility – Entrepreneurship Development Programmes (EDP) - Launching Of Small Enterprise - Definition, Characteristics – Relationship between small and large units – Opportunities for an Entrepreneurial career – Role of small enterprise in economic development – Problems of small scale industries – Institutional finance to entrepreneurs - Institutional support to entrepreneurs.

TOTAL : 45 PERIODS

REFERENCES

1. Bouchoux, D.E., "Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets for the Paralegal", 3rd Edition, Delmar Cengage Learning, 2008.
2. Fleming, D.O. and Hunt, D.L., "Biological Safety: Principles and Practices", 4th Edition, American Society for Microbiology, 2006.
3. Irish, V., "Intellectual Property Rights for Engineers", 2nd Edition, The Institution of Engineering and Technology, 2005.
4. Mueller, M.J., "Patent Law", 3rd Edition, Wolters Kluwer Law & Business, 2009.
5. Young, T., "Genetically Modified Organisms and Biosafety: A Background Paper for Decision-Makers and Others to Assist in Consideration of GMO Issues" 1st Edition, World Conservation Union, 2004.
6. S.S Khanka, "Entrepreneurial Development", S.Chand & Company LTD, New Delhi, 2007.

