

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI
(C.G.)
Scheme of Teaching & Examination
M. Tech. (Industrial Safety Engineering)
II Semester

S. No.	Board of Study	Subject Code	Subject	Periods per Week			Scheme of Examination			Total Marks	Credit L+(T+P)/2
				L	T	P	Theory / Practical				
							ESE	CT	TA		
1	Mechanical Engg.	586211(37)	Computer Aided Risk Analysis	3	1	-	100	20	20	140	4
2	Mechanical Engg.	586212(37)	Safety in Chemical Industry	3	1	-	100	20	20	140	4
3	Mechanical Engg.	586213(37)	Fire Engineering and Explosion Control	3	1	-	100	20	20	140	4
4	Mechanical Engg.	586214(37)	Safety in Material Handling	3	1	-	100	20	20	140	4
5	Refer Table II		Elective - 1	3	1	-	100	20	20	140	4
6	Mechanical Engg.	586221(37)	Industrial Safety Lab.	-	-	3	75	-	75	150	2
7	Mechanical Engg.	586222(37)	CAD / CAM / CAE Technology Lab.	-	-	3	75	-	75	150	2
Total				15	5	6	650	100	250	1000	24

L- Lecture
P- Practical ,
CT- Class Test

T- Tutorial
ESE- End Semester Exam
TA- Teacher's Assessment

Table – II

ELECTIVE - II			
S. No.	Board of Study	Subject Code	Subject
1	Mechanical Engg.	586231(37)	Industrial noise and Vibration Control
2	Mechanical Engg.	586232(37)	Electrical Safety
3	Mechanical Engg.	586233(37)	Safety in construction

Note (1) – $1/4^{\text{th}}$ of total strength of students subject to minimum of twenty students is required to offer an elective in the college in a Particular academic session .

Note (2) – Choice of elective course once made for an examination cannot be changed in future examinations.

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. Tech. - II

Subject: Computer Aided Risk Analysis

Total Theory Periods: 40

Total Marks in End Semester Exam. : 100

Minimum number of Class Test to be conducted: 02

Branch: Mechanical Engg.

Code: 586211(37)

Total Tutorial Periods: 12

Unit-1

HAZARD, RISK ISSUES AND HAZARD ASSESSMENT:- Introduction, hazard, hazard monitoring-risk issue - Hazard assessment, procedure, methodology; safety audit, checklist analysis, what-if analysis, safety review, preliminary hazard analysis (PHA), hazard operability studies (HAZOP)

Unit-2

INSTRUMENTATION:- Applications of Advanced Equipments and Instruments, Thermo Calorimetry, Differential Scanning Calorimeter (DSC), Thermo Gravimetric Analyzer (TGA), Accelerated Rate Calorimeter (ARC), Principles of operations, Controlling parameters, Applications, advantages.

Unit-3

TESTINGS:- 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-4

RISK ANALYSIS QUANTIFICATION AND SOFTWARES:- Fault Tree Analysis & 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 Software on Risk analysis, CISCON, FETI, ALOHA

Unit-5

CONSEQUENCES ANALYSIS:- 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.

References

1. Loss Prevention in Process Industries-Frank P. Less Butterworth-Hein UK 1990 (Vol.I, II & III)
2. Methodologies for Risk and Safety Assessment in Chemical Process Industries, Commonwealth Science Council, UK
3. Hazop and Hazon, by Trevor A Klett, Institute of Chemical Engineering.
4. Quantitative Risk assessment in Chemical Industries, Institute of Chemical Industries, Centre for Chemical process safety.
5. Guidelines for Hazard Evaluation Procedures, Centre for Chemical Process safety, AIChE 1992.

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. Tech. - II

Subject: Safety in Chemical Industry

Total Theory Periods: 40

Total Marks in End Semester Exam. : 100

Minimum number of Class Test to be conducted: 02

Branch: Mechanical Engg.

Code: 586212(37)

Total Tutorial Periods: 12

Unit-1

SAFETY IN PROCESS DESIGN AND PRESSURE SYSTEM DESIGN:- 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-2

PLANT COMMISSIONING AND INSPECTION:- 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-3

PLANT MAINTENANCE, MODIFICATION AND EMERGENCY PLANNING:- 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-4

STORAGES AND TRASPORTATION:- 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, vaporizer, 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 Hazards during transportation – pipeline transport

Unit-5

PLANT OPERATIONS

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. Specific safety consideration for Cement, paper, pharmaceutical, petroleum, petro- chemical, rubber, fertilizer and distilleries.

Text Book

1. Lees, F.P. "Loss Prevention in Process Industries" Butterworths and Company, 1996.

References

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

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. Tech. - II

Subject: Fire Engineering and Explosion Control

Total Theory Periods: 40

Total Marks in End Semester Exam. : 100

Minimum number of Class Test to be conducted: 02

Branch: Mechanical Engg.

Code: 586213(37)

Total Tutorial Periods: 12

Unit-1

Fire chemistry – Dynamics of fire behavior – Fire properties of solid, liquid and gas – Fire spread – Toxicity of products of combustion

Unit-2

Industrial fire protection systems – Sprinkler – Hydrants- Stand pipe- Special fire suppression system like deluge and emulsifier

Unit-3

Bulding evaluation for fire safety – Fire load –Fire resistance materials and fire testing – Structural Fire protection – Exits and egress.

Unit-4

Explosion protection systems – Explosion parameters – Explosion suppression system based on CO2 and Halon – Hazards in L.P.G handling.

Unit-5

Statutory Rules and Techniques of fire fighting - Indian Explosive acts and rules – Techniques of fire fighting and demonstration.

References

1. James, D., *Fire Prevention Handbook*, Butterworths, London, 1986.
2. Gupta R.S., *Handbook of Fire Technology*, Orient Longman, Bombay, 1997.

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. Tech. - II

Subject: Safety in Material Handling

Total Theory Periods: 40

Total Marks in End Semester Exam. : 100

Minimum number of Class Test to be conducted: 02

Branch: Mechanical Engg.

Code: 586214(37)

Total Tutorial Periods: 12

Unit-1

General safety consideration in material handling - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers.

Unit-2

Ergonomic consideration in material handling, design, installation, operation and maintenance of Conveying equipments, hoisting, traveling and slewing mechanisms.

Unit-3

Ergonomic consideration in material handling, design, installation, operation and maintenance of driving gear for hoisting mechanism – Traveling mechanism

Unit-4

Selection, operation and maintenance of Industrial Trucks – Mobile Cranes – Tower crane – Checklist - Competent persons.

Unit-5

Storage and Retrieval of common goods of various shapes and sizes in a general store of a big industry.

References

1. *Accident Prevention Manual for Industrial Operations*, NSC, Chicago, 1982.
2. Alexandrov, M.P., *Material Handling Equipment*, Mir Publishers, Moscow, 1981.
3. Rudenko N., *Material Handling Equipments*, Mir Publishers, Moscow, 1981.

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. Tech. - II

Subject: Industrial noise and Vibration Control

Total Theory Periods: 40

Total Marks in End Semester Exam. : 100

Minimum number of Class Test to be conducted: 02

Branch: Mechanical Engg.

Code: 586231(86)

Total Tutorial Periods: 12

Unit-1

INTRODUCTION:- Basic definitions and terminology used in Vibrations and acoustics – Mathematical concepts and degrees of freedom in vibratory systems – Natural frequencies and vibration modes – continuous systems and wave theory concept – wave equation and relation to acoustics - theory of sound propagation and terminology involved – Plane wave and spherical waves – Concepts of free field and diffuse field, nearfield and farfield – frequency analysis and vibration and noise spectrum – Signature analysis and condition monitoring.

Unit-2

INSTRUMENTATION AND AUDITORY;- Sensors used in vibration and measurements – Frequency and spectrum analysers – Weighting networks – Hearing mechanism – relation between subjective and objective sounds – Auditory effects of noise and audiometric testing – Speech interference levels and its importance.

Unit-3

SOURCES OF NOISE AND RATINGS:- Mechanism of noise generation and propagation in various machinery and machine components, vehicles etc. – Directivity index – Concept of Leq and estimation – Noise ratings and standards for various sources like industrial, construction, traffic, aircraft community etc. – industrial safety and OSHA regulations – Noise legislations and management.

Unit-4

NOISE CONTROL:- Energy transferring and dissipating devices Source: Structure borne and flow excited. Vibration isolation and absorption. Spring and damping materials, Dynamic absorbers, Mufflers and silencers, Path: Close filter and loosely covered enclosures – Acoustic treatment and materials – Transmission loss and absorption coefficient of materials and structures and their estimation – Reverberation time and room constant – Design of rooms / industrial halls/ auditorium for minimum noise. Receiver: Measure to control at the receiver end – use of enclosures, ear muffs and other protective devices.

Unit-5

ABATEMENT OF NOISE:- Active noise attenuators and scope for abatement of industrial noise.

Text Book

1. Irwin, J.D and Graf, E. R, Noise and Vibration Control, Prentice Hall Inc. New Jercey, 1979.

References

1. Irving B Crandall, Theory of Vibrating Systems and Sound, D. Vannostrand Company, New Jercey, 1974.
2. Cyril M. Harris, Hand Book of Noise Control, McGraw Hill Book Company, New York, 1971.
3. White R. G. Walker J. G, "Noise and Vibration", John Wiley and sons New York, 1982.

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. Tech. - II

Subject: Electrical Safety

Total Theory Periods: 40

Total Marks in End Semester Exam. : 100

Minimum number of Class Test to be conducted: 02

Branch: Mechanical Engg.

Code: 586232(86)

Total Tutorial Periods: 12

Unit-1

Review of Electrical concept, Electrostatic – Electro magnetism – Stored energy – Working principle of major electrical equipment – Typical supply situation

Unit-2

Standards and statutory requirements – Indian electricity acts and rules – statutory requirements from Electrical inspectorate.

Unit-3

Electrical Hazards – Energy leakage – Clearance and insulation – Excess energy – Current surges – Electrical causes of fire and explosion – National electrical Safety code.

Unit-4

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance

Unit-5

Hazardous area classification and classification of electrical equipments for hazardous areas (IS, API and OSHA standards).

References

1. Fordham Cooper W., *Electrical Safety Engineering*, Butterworths, London, 1986.
2. *Accident Prevention Manual for Industrial Operations*, NSC, Chicago, 1982.
3. www.osha.gov

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. Tech. - II

Subject: Safety in construction

Total Theory Periods: 40

Total Marks in End Semester Exam. : 100

Minimum number of Class Test to be conducted: 02

Branch: Mechanical Engg.

Code: 586233(37)

Total Tutorial Periods: 12

Unit-1

General safety consideration – analyzing construction jobs for safety – Contract document – Safety certificate for statutory authorities for old building and construction

Unit-2

Excavation, foundation and utilities – Cordoning – Demolition – Dismantling –Clearing debris – Types of foundations – Open footings.

Unit-3

Safety in Erection and closing operation - Construction materials –Specifications – suitability – Limitations – Merits and demerits – Steel structures –Concrete structure.

Unit-4

Safety in typical civil structures – Dams-bridges-water Tanks-Retaining walls-Critical factors for failure-Regular Inspection and monitoring.

Unit-5

Maintenance –Training-Scheduling-Preventive maintenance-Lock out of Mechanical and Electrical maintenance-ground maintenance-hand tools-Gasoline operating equipment.

References

1. *Accident Prevention Manual for Industrial Operations*, NSC, Chicago, 1982.
2. Fulman, J.B., *Construction Safety, Security, and Loss Prevention*, John Wiley and Sons, 1979.

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. Tech. - II
Subject: Industrial safety Lab.
Total Lab Periods: 40
Total Marks in End Semester Exam. : 75

Branch: Mechanical Engg.
Code: 586221(37)

List of Experiments (to be performed at least 7 experiments)

- 1. NOISE LEVEL MEASUREMENT AND ANALYSIS:-** Measurement of noise level for various sources – Impact, continuous and intermittent. Frequency and spectrum analysis of noise:
Instrument – precision type of Noise level meter with frequency and spectrum analyzer.
- 2. VIBRATION MEASUREMENT AND ANALYSIS:-** Measurement of whole body vibration for various acceleration: *Instrument – vibration simulator and vibration analyzer.*
- 3. FRICTION SENSITIVITY TEST:-** Measurement of friction sensitivity for unstable materials:
Instrument – BAM friction tester.
- 4. IMPACT SENSITIVITY TEST:-** Measurement of impact sensitivity for unstable materials:
Instrument – BAM fall hammer
- 5. THERMAL REACTIVITY TEST:-** Measurement of thermal reactivity for unstable materials:
Instrument – DSC/TGA
- 6. EXHAUST GAS MEASUREMENT AND ANALYSIS:-** Measurement of Exhaust gas measurement of IC engines: *Instrument – Gas analyzer*
- 7. BREATHING ZONE CONCENTRATION:-** Measurement of breathing zone concentration of dust and fumes: *Instrument – personal air sampler*
- 8. AMBIENT AIR MONITORING:-** Measurement of respirable and non-respirable dust in the ambient air: *Instrument – High volume sampler*
- 9. CONSEQUENCE ANALYSIS:-** Soft computing skills on developing effects of fire & explosion and dispersion: *Software – PHAST 1 and ALOHA.*
- 10. STUDY OF PERSONAL PROTECTIVE EQUIPMENT:-** Safety helmet, belt, hand gloves, goggles, safety shoe, gum boots, ankle shoes, face shield, nose mask, ear plug, ear muff, apron and leg guard.
- 11. STUDY OF FIRE EXTINGUISHERS:-** Selection and demonstration of first-aid fire extinguishers: soda acid, foam, carbon dioxide (CO₂), dry chemical powder, halon.

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. Tech. - II

Subject: CAD / CAM / CAE Technology Lab.

Total Lab Periods: 40

Total Marks in End Semester Exam. : 75

Branch: Mechanical Engg.

Code: 586222(37)

List of Experiments

- To be able to understand and handle design problems in a systematic manner.
- To gain practical experience in handling 2D drafting and 3D modeling software systems.
- To be able to apply CAD in real life applications.
- To understand the concepts G and M codes and manual part programming.
- To expose students to modern control systems (Fanuc, Siemens etc)
- To know the application of various CNC machines
- To expose students to modern CNC application machines EDM, EDM wire cut and Rapid Prototyping

Modeling through Software's:-

1. 3D –Part modeling of a component by using extrusion.
2. 3D –Part modeling of a component by using resolve.
3. 3D –Part modeling of a component by using shell.
4. 3D –Part modeling of a component by using rib.
5. Creation of Various assembly models.