KALINGA UNIVERSITY

RAIPUR | INDIA

SCHEME & SYLLABUS FOR

Bachelor of Vocational Studies (B.Voc.)
Fire and Safety Management

NAAC GRADE B+ Accredited University

nirf RANKING 2024 Ranked in Top 151-200 Universities

Kalinga University, Naya Raipur, Chhattisgarh

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B.VOC IN FIRE AND SAFETY MANAGEMENT

Semester - I								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total**
BVFSM101	Communication Skills	3	3	0	0	30	70	100
BVFSM102	Fundamentals of Information Technology	3	3	0	0	30	70	100
BVFSM103	Chemistry of Combustion	3	3	0	0	30	70	100
BVFSM104	Fundamentals of Fire and Safety	3	3	0	0	30	70	100
BVFSM105P	**Industrial Training/On Job Training/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

Semester - II								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total**
BVFSM201	Basics of Firefighting and Control	3	3	0	0	30	70	100
BVFSM202	Environmental Studies	3	3	0	0	30	70	100
BVFSM203	Safety Management	3	3	0	0	30	70	100
BVFSM204	First Aid	3	3	0	0	30	70	100
BVFSM205P	**Industrial Training/On Job Training/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

Semester - III								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total**
BVFSM301	Rescue Techniques	3	3	0	0	30	70	100
BVFSM302	Manual and Portable Firefighting Equipment	3	3	0	0	30	70	100
BVFSM303	Chemical and Oil Industries Safety Management	3	3	0	0	30	70	100
BVFSM304	Materials Science	3	3	0	0	30	70	100
BVFSM305P	**Industrial Training/On Job Training/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

Semester - IV								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total**
BVFSM401	Fire Codes and Standards	3	3	0	0	30	70	100
BVFSM402	Fire Hydraulics and Suppression System	3	3	0	0	30	70	100
BVFSM403	Explosions and Industrial Fire Safety	3	3	0	0	30	70	100
BVFSM404	Management and Risk Assessment	3	3	0	0	30	70	100
BVFSM405P	**Industrial Training/On Job Training/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

Semester - V								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total**
BVFSM501	Fire Dynamics	3	3	0	0	30	70	100
BVFSM502	Fire Detection System and Electrical Safety	3	3	0	0	30	70	100
BVFSM503	Safety in Construction	3	3	0	0	30	70	100
BVFSM504	Unit Operations -I	3	3	0	0	30	70	100
BVFSM505P	**Industrial Training/On Job Training/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

Semester - VI								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total**
BVFSM601	Disaster Management and Emergency Preparedness	3	3	0	0	30	70	100
BVFSM602	Hazard Identification and Risk Analysis	3	3	0	0	30	70	100
BVFSM603	Smoke Management System	3	3	0	0	30	70	100
BVFSM604	Unit Operations -II	3	3	0	0	30	70	100
BVFSM605P	**Industrial Training/On Job Training/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

Program Outcomes:

- PO1: Demonstrate fire prevention practices, per NFPA 1021 guidelines.
- PO2: Demonstrate knowledge of the financial processes associated with the fire service.
- PO3: Demonstrate and apply fire-ground operations management, to include applicable NFPA standards and guidelines.
- PO4: Demonstrate knowledge of fire service organization and management.
- PO5: Demonstrate knowledge of an effective emergency management program to include applicable NFPA standards and guidelines.
- PO6: Demonstrate knowledge of basic fire protection engineering concepts, fire protection systems evaluation and design, as it relates to risk reduction.
- PO7: Demonstrate fundamental knowledge of the functions of planning, organizing, directing and controlling as applicable to leadership in fire and industrial safety.
- PO7: Demonstrate fundamental knowledge of the local, state and national standards appropriate to fire safety.
- PO8: Demonstrate fundamental knowledge of human resources and safety management as it relates to thework place.
- PO9: Demonstrate written and oral communication skills, applicable to fire and industrial safety

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SEMESTER-01

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BVFSM101
COMMUNICATION SKILLS

Course Objective:

- The purpose of this course is to introduce students to the theory, fundamentals and tools of communication and to develop in them vital communication skills which should be integral to personal, social and professional interactions. One of the critical links among human beings and an important thread that binds society together is the ability to share thoughts, emotions and ideas through various means of communication: both verbal and non-verbal. In the context of rapid globalization and increasing recognition of social and cultural pluralities, the significance of clear and effective communication has substantially enhanced.

Course outcomes:

- The purpose of this course is to introduce students to the theory, fundamentals and tools of communication
- To develop vital communication skills which should be integral to personal, social and professional interactions.
- One of the critical links between human beings.
- An important thread that binds society together is the ability to share thoughts, emotions and ideas through various means of communication: both verbal and non-verbal.
- In the context of rapid globalization and increasing recognition of social and cultural pluralities, the significance of clear and effective communication has substantially enhanced.

Unit 1: **06**

- **Introduction:** Theory of communication, types and modes of communication, mediums and channels of communication, barriers to communication, English as a global language, the lingua franca, social influences on English

Unit 2: **06**

- **Language of Communication:** Verbal and non-verbal (spoken and written) personal, social and business barriers and strategies intra-personal, inter-personal and group communication, varieties of English, language, accent, dialect, colloquialism, historical influences on English

Unit 3: **06**

- **Speaking Skills:** Monologue dialogue group discussion effective communication/mis-communication interview public speech, regional influences on English, convergence and divergence, linguistic imperialism

Unit 4: **06**

- **Reading and Understanding** Close reading, reading analysis of a text - audience and purpose, content and theme, tone and mood, stylistic devices, structure comprehension- analysis and interpretation translation(from Indian language to English and vice-versa) literary/knowledge texts

Unit 5: **06**

- **Writing Skills**: Documenting report writing making notes letter writing, writing tabloids, diary entry, open letters, essays, newsletter and magazine articles, skits, short stories, impersonating characters it will enhance language of communication, various speaking skills such as personal communication, social interactions and communication in professional situations such as interviews, group discussions and office environments, important reading skills as well as writing skills such as report writing, note taking etc. while, to an extent, the art of communication is natural to all living beings, in today's world of complexities, it has also acquired some elements of science. it is hoped that after studying this course, students will find a difference in their personal and professional interactions.

References:

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr. Ranjana Kaul, Dr. Brati Biswas

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BVFSM102

FUNDAMENTALS OF INFORMATION TECHNOLOGY

Course objective:

- This is a basic course for commerce students to familiarize with computer and it's applications in the relevant fields and exposes them to other related courses of IT.

Course Outcomes:

- Gain a foundational understanding of key IT concepts, including hardware, software, and networks.
- Develop proficiency in using common computer applications, such as word processing and spreadsheet software.
- Explore the ethical and security considerations in IT, emphasizing responsible digital behavior.
- Acquire problem-solving skills by applying IT knowledge to real world scenarios.
- Prepare for further studies in IT or related fields by establishing a strong IT knowledge base.

Unit-1: **06**

- **Computer characteristics:** Speed, storage, accuracy, diligence; digital signals, binary system, ASCII; historic evolution of computers;
- **Classification of computers:** microcomputer, minicomputer, mainframes, supercomputers;
- **Personal computers:** desktop, laptops, palmtop, tablet; hardware & software; von Neumann model.

Unit-2: **06**

- **Hardware:** CPU, memory, input devices, output devices.
- **Memory units:** RAM (SDRAM, DDR RAM, RDRAM etc. feature wise comparison only); ROM-different types: Flash memory;
- **Auxiliary storage:** Magnetic devices, optical devices; floppy, hard disk, memory stick, CD, DVD, CD/DVD-Writer**;**
- **Input devices -** keyboard, mouse, scanner, speech input devices, digital camera, touch screen voice input, joystick, optical readers, bar code reader;
- **Output devices:** Display device, size and resolution; CRT, LCD, LED;
- **Printers:** Dot-matrix, inkjet, laser; plotters, sound cards & speaker.

Unit-3: **06**

- **Software:** System software, application software; concepts of files and folders, introduction to operating systems, different types of operating systems: single user, multitasking, time-sharing multi-user; booting, POST;
- **Basic features of two GUI operating systems:** Windows & Linux (Basic desk top management); Programming Languages, Compiler, Interpreter, Databases;
- **Application software:** Generic features of word processors, spread sheets and presentation software; generic introduction to latex for scientific typesetting; utilities and their use; computer viruses & protection, free software, open source.

Unit-4: **06**

- **Computer Networks and Internet:** Connecting computers, requirements for a network: server, workstation, switch, router, network operating systems; internet: brief history, world wide web, websites, URL, browsers, search engines, search tips; internet connections: isp, dial-up, cable modem, well, dsl, leased line wireless and Wi-Fi connectivity ; email, email software features (send receive, filter, attach, forward, copy, blind copy); characteristics of web-based systems, web pages, web programming languages.

Unit-5: **06**

- **Information Technology and Society:** Indian IT Act, intellectual property rights, issues. application of information technology in railways, airlines, banking, insurance, inventory control, financial systems, hotel management, education, video games, telephone exchanges, mobile phones, information kiosks, special effects in movies.
- **Programming Concepts & Techniques:** Program concept, characteristics of programme, stages in program development, tips for program designing, programming aids, algorithms, pseudo code, notations, design, flowcharts, symbols, rules, compiler & interpreter. introduction to programming techniques, top-down & bottom-up approach, unstructured, & modular programming, cohesion, coupling, debugging, syntax & logical errors, linking and loading, testing and debugging, documentation.

References:

1. Programming in C, R.S. Salaria, Khanna Publishing House
2. Computer Concepts and Programming in C, R.S. Salaria, Khanna Publishing House
3. Handbook of Computer Fundamentals, N.S. Gill, Khanna Publishing House

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BVFSM103

CHEMISTRY OF COMBUSTION

Course Objectives:

- Understand concepts and fundamentals of chemistry related to combustion process.
- To provide knowledge of important terms, concepts and processes associated with combustion and ignition
- To make students aware of special combustion processes associated with certain fuels and situations.
- To become familiar with different fuel properties used to characterize the combustion hazard
- Make students aware of significant chemical groups and their properties which influence their behavior with respect to combustion.

Unit 1: **08**

- Basic chemical concepts related to atoms & molecules, compounds & mixtures, radicals, atomic & molecular mass, valency, nomenclature, simple & complex equations, stoichiometric equations, use and limitations of chemical equations, reaction conditions, heat and rate of reaction.

Unit 2: **08**

- Fundamentals of combustion, concept of fire triangle and fire tetrahedron (role of active radicals), heat of reaction and calorific values of fuels, oxidation reactions, laminar and turbulent flow, premixed and diffusion flames, combustion in gases, liquids, solids, concept of flashpoint, fire point, ignition temperature, Phenomena related to compartment fires – flashover, blowback. Explosive burning, vapour cloud explosions.

Unit 3: **07**

- **Behaviour of different solids during combustion –** wood, coal, sulphur, phosphorus, metals, polymers, dusts, monomers, intermediates, hardeners. Special combustion phenomena involving solids - smouldering fires, spontaneous heating and combustion

Unit 4: **07**

- **Properties and characteristics of different oxidizing agents-** Nitric acid and inorganic nitrates, permanganates, chlorates, chromates and dichromates, inorganic peroxides, organic oxidizing agents, organic peroxides and hydroperoxides
- **Properties and characteristics of organic compounds –** aliphatic hydrocarbons (paraffins or alkanes), unsaturated aliphatic hydrocarbons, olefines or alkenes, acetylenes, or alkynes, aromatic hydrocarbons, liquefied petroleum gases (LPG), simple oxygen-containing compounds derived from hydrocarbons, alcohols, aldehydes, ketones, carboxylic acids, esters & ethers

References:

1. Fire Service Manual Volume 1, Physics & Chemistry for Firefighters, HMSO Publications
2. Cote, Arthur, Section 2 & 6, Fire protection Handbook, 20th Edition, NFPA
3. Purandare D.D. Handbook on Industrial Fire Safety, P&A Publications
4. Wharry, Hirst, Fire Technology - Chemistry & Combustion, IFE

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BVFSM104
FUNDAMENTALS OF FIRE AND SAFETY

Course Objectives:

- Understand the challenges to safety in built and industrial environment and approaches to addressing the same.
- Become aware of the history and current role of safety related legislation and role of agencies involved with implementation.
- Understand different design approaches for addressing fire and safety challenges in the built environment
- Become familiar with current fire & safety engineering and management concepts and practices followed in the industry

Unit 1: **08**

- Challenges to safety in built environment, types of hazards likely to cause harm (fire, burns, electric shock, falls), natural disasters, fatalities involving hazardous environments. Approach to addressing fire and safety challenges at organization and national level.

Unit 2: **08**

- The Concept of industrial safety, its need, nature and importance. Focus on Human resource, and concept of importance of 'man' as central theme in safety. Concept of accident prevention, occupational health and environmental protection. Problems of Industrial safety, occupational health and environmental pollution & modern concept of SHE.

Unit 3: **07**

- History and role of building codes and safety legislation, concept of safety versus risk, enforcement of codes and standards, role of government agencies and emergency services in enforcing legislation, government framework and infrastructure involved in safety legislation enforcement. Role of code enforcement, plan review and approval, record keeping, public education, etc., in fire & safety

Unit 4: **07**

- Design approaches for fire and safety, NFPA fire safety concepts tree, fire safety design objectives, strategies and tactics; fire prevention, control, detection and alarm, suppression, managing the exposed. Code based and performance-based design approaches – their advantages and shortcomings.
- **Industrial Fire & Safety management concepts –** hazard identification and risk assessment, risk reduction and control methods. Design aspects such as segregation and separation, fire resisting construction, emergency exit arrangements, access for emergency agencies, fire protection systems, safe operational practices, maintenance and upkeep of systems, planning for emergency response.

References:

1. Cote, Arthur, Section 1, Fire protection Handbook, 20th Edition, NFPA
2. Handbook of Industrial Safety by K.U. Mistry, Siddarth Prakashan, Gujarat
3. Industrial Accident Prevention by H.W. Heinrich, McGraw Hill Book Co.
4. Techniques of Safety Management by Dan Pederson.
5. Purandare D.D. Handbook on Industrial Fire Safety, P&A Publications
6. Cheunisinoff & Graffia, Environmental Health & Safety Management, Reprint Jaico Publishing House.
7. Tarafdar, Industrial Safety Management

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BVFSM105P
INDUSTRIAL TRAINING/ON JOB TRAINING/ WORKSHOP

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SEMESTER-02

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BVFSM201
BASICS OF FIREFIGHTING AND CONTROL

Course Objectives:

- To study about construction techniques.
- To know about extinguishing agents.
- To identify the Fire prevention.

Course Outcomes:

- Learn emergency procedure in the event of a fire.
- Understand how people perceive and react to fire danger.
- Receive the overcome behavioral problems

Unit 1: **08**

- History of fires, types of detecting devices and extinguishing agents and systems, construction techniques, and fire investigation.

Unit 2: **08**

- Classification of fire, different fire extinguishing methods, Portable fire extinguishers, Pumps and primers, Foam and foam making equipments.
- Hose and hose fittings, Water relay systems, types of detecting devices and extinguishing agents.

Unit 3: **07**

- Breathing apparatus, Small gears, Fire protective clothing, Ladders, Ropes and lines, bends & hitches, Fire prevention, Special appliances, Firefighting codes and standards, Electrical fire hazards, Structures under fire.

Unit 4: **07**

- Safety of People in the event of Fire, Recognition of possible fire sources and emergency procedures in the event of a fire
- Devising procedures in the event of fire, how people perceive and react to fire danger,
- The measures needed to overcome behavioral problems and to ensure the safe evacuation of people in the event of fire, assisting disabled people to escape.

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BVFSM202
ENVIRONMENTAL STUDIES

Course Outcomes:

- Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
- Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
- Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
- Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
- Master core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.

Unit 1: **06**

Introduction to Environmental Studies:

- Multidisciplinary nature of environmental studies, Scope and importance; concept of sustainability and sustainable development.

Ecosystems:

- What is an ecosystem? Structure and function of the ecosystem;
- **Energy flow in an ecosystem:** food chains, food webs and ecological succession.
- **Case studies of the following ecosystems**: Forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit-2: **06**

Natural Resources:

- **Renewable and Non--renewable Resources:** Land resources and land use change; Land degradation, soil erosion and desertification.
- **Deforestation:** Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- **Water:** Use and over--exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter--state).
- **Energy resources:** Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit-3: **06**

Biodiversity and Conservation:

- **Levels of biological diversity:** genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots, India as a mega--biodiversity nation; Endangered and endemic species of India
- **Threats to biodiversity:** Habitat loss, poaching of wildlife, man--wildlife conflicts, biological invasions;
- **Conservation of biodiversity:** In--situ and Ex--situ conservation of biodiversity.
- **Ecosystem and biodiversity services:** Ecological, economic, social, ethical, aesthetic and Informational value.

Unit-4: **06**

Environmental Pollution:

- Types, causes, effects and controls; Air, water, soil and noise pollution, Nuclear hazards and human health risks
- **Solid waste management:** Control measures of urban and industrial waste. Pollution case studies.

Environmental Policies & Practices:

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- **Environment Laws:** Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Unit-5: **06**

Human Communities and the Environment:

- **Human population growth:** Impacts on environment, human health and welfare. Resettlement and rehabilitation of project affected persons; case studies.
- **Disaster management:** floods, earthquake, cyclones and landslides.
- **Environmental movements:** Chipko, Silent valley, Bishnois of Rajasthan.
- **Environmental ethics:** Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

References:

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999.Global Ethics and Environment, London, Routledge.
4. Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll.Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36--37.
7. McCully, P. 1996. Rivers no more: the environmental effects of dams(pp. 29--64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971.Fundamentals of Ecology. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. Waste Water Treatment. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.Environment. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. Environmental law and policy in India. Tripathi 1992.
14. Sengupta, R. 2003. Ecology and economics: An approach to sustainable development. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
17. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
18. Warren, C. E. 1971. Biology and Water Pollution Control. WB Saunders.
19. Wilson, E. O. 2006.The Creation: An appeal to save life on earth. New York: Norton.
20. World Commission on Environment and Development. 1987.Our Common Future. Oxford University Press.

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BVFSM203
SAFETY MANAGEMENT

Course Objectives:

- To find out Safety Management System.
- To identify Training Objectives and Methods.
- To know the Rules and regulation of safety department.

Course Outcomes:

- Understand the Safety and Health Management
- Develop the relationships within the organization.
- Learn the Safety activities of the ILO

Unit 1: **08**

- Key elements of a safety Management, Policy & commitment, Planning, Implementation and Operation, Measuring Performance, Auditing and reviewing performance Initial Safety Management System Review, Safety Management System - Developing a workplace Safety and Health Policy.

Unit 2: **08**

- **Safety and Health Management System records:** Operational Control –Workplace Precautions, Safety and Health training and Competence Training for Safety and Health.

Unit 3: **07**

- **Identify Training Needs –** Organizational needs, job-related Needs, Individual Needs : Identify Training Objectives and Methods, Deliver Training , Evaluation and feedback, specialist Advice and Services – access to Specialist advice and services, relationships within the Organization , relationships Outside the organization , external specialist safety and safety support.

Unit 4: **07**

- Stages in plant life and unsafe condition in factories, maintenance & safety, basics safety programming, safety department, Rules and regulation of safety department.
- Responsibility of management for safety in plant, safe guarding the public, Responsibility of government, social organization and public authorities. Safety activities of the ILO (International Labour Organization)

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BVFSM204
FIRST AID

Course Objectives:

- To know about Surface Causalities.
- To study the precaution during search and rescue.
- To identify Ropes and Knots.

Course Outcomes:

- Understand the Action plan for Transport of injured Person
- Learn Emergency Evacuation.
- Receive the First aid

Unit 1: **08**

- **Introduction –** Search and Rescue – Stages of Rescue – Surface Causalities –Searching slightly damaged buildings- Exploration of likely survival points –selected debris removal – searching methods – Physical search – canine search– Technical search – Hailing search method – Diagrammatic representation of hailing search method – Advantages of hailing search – precaution during search and rescue.

Unit 2: **08**

- **Ropes and Knots –** Ropes – Natural Fibre Rope – Synthetic Fibre Rope -Synthetic Fibre Rope – Nylon Rope – Poly Rope – Braided Synthetic Rope –Knots – Knots at the end of a ropes – knots for joining two Ropes – Knots for making Loops – Hitches.

Unit 3: **07**

- **Search and rescue methods –** water rescue – Emergency rescue – Staircase Drag Method – Firemen crawl method – Search and rescue kit – Action plan for Transport of injured Person – Reporting – Action on the recommendations –Accident / Incident Report Form.

Unit 4: **07**

- **Evacuation –** Evacuation signal – Participatory Rural Appraisal – Resources –Resource Mapping – Social Mapping – Processes for Resources Mapping –Emergency Evacuation – Emergency situation
- **First aid –** Principles and practice of first aid – Scope of first aid – The general principal of first aid – Types of Bleeding – shock – Treatment for electric shock, asphyxiation (suffocation) and drowning – Type of shock – Fracture –Burn –Transportation – Resuscitation Chart (CPR) – First Aid Kit – Basics of Backpacking First Aid – Equipment – PPE (Personal Protective Equipment) –Contents of First Aid Box.

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BVFSM205P
INDUSTRIAL TRAINING/ON JOB TRAINING/ WORKSHOP

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SEMESTER-03

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BVFSM301
RESCUE TECHNIQUES

Course Objectives:

- To provide fundamental understanding of different rescue actions required and techniques adopted in ordinary and extraordinary accidents, including disasters.
- To understand function and working of different respiratory and non-respiratory Personal Protective Equipment and specialized rescue equipment used by rescuers in emergencies
- To learn about the human body & its various systems
- To learn about the paramedic science related to handling of human casualty and diagnosis.
- Gain theoretical and practical knowledge related to first aid treatment for burn, shock and other types of serious injuries

Unit 1: **08**

- The purpose and understanding of different rescue actions used in emergencies. Fundamental actions and techniques applied for rescue of victims in fire and other similar emergencies (Fires, Lift accidents, Car accidents, etc.). Understand rescue techniques applied for special hazards such as building collapse, trenches, sewers, machinery, etc. Recognize important allied functions required (such as trauma care, triage) in large scale emergencies/ disasters.

Unit 2: **08**

- **Physiology of respiration, respiratory protective apparatus -** Gas masks, Breathing Apparatus sets - types, constructional features, working principle and applications, calculation of the capacity & time duration of the B.A.set. Features of other important PPEs used during rescue operations. Overview of different electric, hydraulic, and pneumatically operated rescue tools and equipment commonly used in emergencies- Hydraulic Jack, Hydraulic Cutter, Hydraulic Expander, Air Lifting Bags, Electric Cutter, Electric Saw, Chain saw etc.

Unit 3: **07**

- **Study of a Human Casualty:** Including history taking, making of a diagnosis based on symptoms as narrated by the casualty and signs as observed by the paramedic. Checking temperature pulse, respiration, blood pressure, swellings, and discoloration of the skin, wounds, deformities etc. /to confirm the diagnosis. Casualties with affected vital functions, such as casualties in unconscious state, asphyxia, shock including their causes symptoms, signs and specific aspects of examination of such casualties and maintenance of records during their observation and care at the place incident and during transportations up to hospital. Study of specific injuries to body parts controlling their functions with external and internal injuries of head chest and abdomen including causes and consequences of external and internal bleeding.

Unit 4: **07**

- First aid/paramedic care of various types of Casualties and their injuries such as wounds, burns, injuries of bones and joints, disturbances in vital function including cardiopulmonary resuscitation, artificial respiration by manual and instrumental methods, bandages, splints, correction of shock, arrest of bleeding, treatment of hyperpyrexia, use of anti/shock fluids and their administration, Observation and maintenance of such causalities. Casualty handling including observation, maintenance of observation charts, treatment administered, temperature-pulse-respiration records, application of suction, appropriate positioning of casualties affected by head injuries, chest injuries, abdominal injuries, bleeding, shock, asphyxia etc

References:

1. Fire Service Manual Volume 2 Incidents Involving Rescue from Road Vehicles, HMSO Publications
2. Practical Firemanship II, Manual of Firemanship, HMSO Publications
3. Manual of Firemanship, Book 5, Ladders & Appliances, HMSO Publications
4. Elementary principles of rescue by Govt. Of India, Ministry of Home Affairs
5. Product Data sheets & Operation/Maintenance Manuals for Rescue Equipments
6. L.G Gupta & Abhitabh Gupta, First Aid, Jaypee Brothers.
7. Cantlie, James, First Aid to injured,
8. St John Ambulance Association First Aid Manual by Indian Red Cross Society.
9. Rescue –Civil Defense Handbook by HMSO
10. Relevant ISI standards - Special appliances and equipments

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BVFSM302
MANUAL AND PORTABLE FIREFIGHTING EQUIPMENT

Course Objectives:

- To provide fundamental understanding of different firefighting actions and techniques employed for fire incidents.
- To understand function and working of different manual and portable firefighting equipment, including extinguishers, hose reels,
- hoses and different water and foam branches and fittings
- Introduction to related codes and standards and the operational requirements and specifications of portable and mobile firefighting equipment.
- Be able to operate manual and portable firefighting equipment and carry out testing and maintenance of the same

Unit 1: **08**

- Understanding the combustion process and how different extinguishing methods are employed depending on type of fuel involved, the characteristics and properties of different extinguishing agents, their suitability for different fuels and fire situations, and other factors. Classification of fires for portable extinguishers.

Unit 2: **08**

- Different types of fire extinguishers, their construction, design requirements, and operating mechanisms. Importance of operating techniques for different types of fires and different scenarios. Familiarization with related codes and standards e.g., IS:2190, IS:15683, IS:2878, NFPA 10

Unit 3: **07**

- Use of different branches in firefighting i.e., hose reel nozzle, short branch, basic spray nozzle, selectable flow nozzle, revolving nozzle, piercing nozzle, etc., in firefighting and their operational features. Different types of hoses being used in firefighting and their performance and testing requirements. Standards related to Firefighting branches and hoses (IS:884, IS:904, IS:906, IS:2871, IS:8423, IS:636,etc.).

Unit 4: **07**

- Understand use and application of portable foam equipment commonly used by the Fire Service i.e., foam branches of different types, foam generators, portable foam inductors, etc. Become familiar with Indian/international standards and industry specific specifications for these equipment (IS:2097, NFPA 11, NFPA 11, etc.
- Appreciate the importance of proper ITM practices for effective operation of manual and portable firefighting equipment. Become familiar with ITM requirements as stated in standards and OEM manuals, and be able to interpret and execute the same in a practical and safe manner.

References:

1. Fire Service Manual Volume 1, Inspection & Testing of Equipment, HMSO Publications
2. Fire Service Manual Volume 1, Firefighting Foam-Technical, HMSO Publications
3. Manual of Firemanship, Book 2 –Fire Brigade Equipment, HMSO Publications
4. Purandare D.D. Handbook on Industrial Fire Safety, P&A Publications
5. Various IS & International Standards (IS:884, IS:904, IS:906, IS:2871, IS:8423, IS:636, IS:2097, NFPA 10/ 11, OISD 117/118
6. Rescue –Civil Defense Handbook by HMSO
7. Relevant ISI standards - Special appliances and equipments

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BVFSM303
CHEMICAL AND OIL INDUSTRIES SAFETY MANAGEMENT

Course objectives:

- To identify Industry Accidents.
- To know about Safety Precautions for transporting hazardous.
- To study the Safety in chemical industry.

Course Outcomes:

- Understand the Safety Management (PSM) in the oil industries.
- Learn the Control measures to minimize explosion.
- Develop the effective emergency response.

Unit 1: **08**

- **Review of Industry Accidents:** Major Oil Industry Accidents, Major Chemical Industry Accidents, the Mexico LPG Disaster, Bhopal Disaster, Phillips Disaster.

Unit 2: **08**

- Classification of chemicals, Safety in chemical industry, Criteria for layout of chemical plants, Instrumentation for safe plant operations. Control, precautions and prevention, specific safety measures for chemical industry.

Unit 3: **07**

- Safety Precautions for transporting hazardous / toxic / flammable /explosive/ radioactive chemicals by all modes, transfer of chemicals by pipelines within and outside installations, above and under ground

Unit 4: **07**

- The fire hazards, risks and controls available for safe containment of oil and hydrocarbons offshore and onshore, Outline the hazards, risks and controls relating to hydrocarbon Process Safety Management (PSM) in the oil industries,
- Control measures to minimize the effects of fire and explosion in the oil and gas industries, the principles, procedures and resources for effective emergency response.

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BVFSM304
MATERIALS SCIENCE

Course Objectives:

- To understand the classification of materials, bonding and the crystal structure.
- To understand the Properties of conducting, insulating, semiconducting, dielectric and semiconductor materials.

Course Outcomes:

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

- Describe the fundamentals of material science and concepts of unit cell & crystallography.
- Classify materials based on their conducting, insulating, semiconducting, dielectric properties.
- Know the practical uses of various materials in different electrical engineering field.

Unit 1: **08**

- **Introduction:** Introduction and historical importance of Materials, Classification of Materials, Engineering Materials, Advanced Materials and Future Materials like ceramics, polymers, composites, Dielectric etc.
- Bravais Lattices, Crystal Structures, Crystalline, Quasi Crystalline and Non-Crystalline Materials, Miller Indices, Miller-Bravais Indices for Planes and Directions of Cubic and Non-Cubic Structures, structure of ceramics, polymers, and composites materials. Classical theory of electrical and thermal conduction in solids, temperature dependence of resistivity, skin effect, Hall Effect.

Unit 2: **08**

- **Diffusion and Heat treatment:** Phase Diagrams: Phase Rule, Equilibrium Phase Diagrams, Phase Systems - Isomorphous, Eutectic with No and Limited Solid Solubility and Peritectic, Iron-Carbon Phase Diagram, TTT Diagram.
- **Imperfections in Solids and Strengthening Mechanisms:** Point Defects, Line Defects and Dislocations, Interfacial Defects and Bulk or Volume Defects, Recovery, Recrystallization and Grain Growth. Alteration of properties by heat treatment, Heat treatment method, Quantification of altered material properties by heat treatments.

Unit 3: **07**

- **Mechanical behavior of Metals and Alloys:** Types of Loading, Stress-Strain Curves for Brittle and Ductile Materials, Theoretical and Observed Shear Stress, Critical Resolved Shear Stress, Deformation – Elastic, Anelastic, Plastic and Super Plastic, Yield Criteria, Macroscopic Aspects of Plastic Deformation, Toughness Measurements by S-S Curve, Impact Testing and Fracture Toughness Testing.
- **Types of Mechanical Loading and Failures**: Ductile and Brittle Fracture, Modes of Fracture Toughness, Impact Fracture, Ductile-Brittle Transition, Types of Impact Testing, Fatigue, Crack Initiation and Propagation, Fatigue Testing, Creep, Stages of Creep Curve, Stress and Temperature Effects.

Unit 4: **07**

- **Dielectric and Magnetic Property of Materials:** Introduction, polarization of dielectric material, dielectric constant of monatomic gases, frequency dependence of permittivity, dielectric losses, frequency and temperature dependence of the dielectric constant, dielectric properties of polymeric system, ionic conductivity in insulators, insulating materials, Ferro electricity, piezoelectricity.
- Introduction, Classification of magnetic materials, diamagnetism, paramagnetism, ferromagnetism, magnetization curve, the hysteresis loop, factors affecting permeability and hysteresis loss, common magnetic materials, magnetic resonance.
- **Properties of Metals and Semiconductors:** Energy band in Metals, Semiconductors and Insulators, types of semiconductors, Intrinsic and Extrinsic semiconductors, Effect of temperature on the electrical conductivity of metals, insulator and semiconductor, thermal properties, thermal conductivity of metals and semiconductors, factors affecting the resistivity of electrical materials, electrical conductivity of doped materials, thermoelectric effects.

References:

1. C.S.Indulkar and S. Thiruvengadam, S., “An Introduction to Electrical Engineering”.
2. P L Kapoor. A Textbook of Electrical and Electronics Engineering Materials: Khanna publishers
3. Kenneth G. Budinski, “Engineering Materials: Prentice Hall of India, New Delhi

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BVFSM305P
INDUSTRIAL TRAINING/ON JOB TRAINING/ WORKSHOP

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SEMESTER-04

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BVFSM401
FIRE CODES AND STANDARDS

Course Objectives:

- To provide in-depth view of fire/combustion science.
- To introduce the concepts of fire protection/suppression engineering principles & systems currently followed in Oil & Gas industrial sector
- To brief the legislation requirements-national/international codes/ standards from fire & safety perspective

Course Outcomes:

- Gain knowledge on extinguishment of different kinds of fire & demonstrate the usage of various fire extinguishers.
- Identify & explain different types of fire protection systems/ installations in oil and gas industry
- Summarize the fire safety requirements for buildings of different occupancy as per the National Building Code of India

Unit 1: **08**

- **Introduction: Fire:** Definition of Fire, Fire Triangle, Tetrahedron of Fire, Classification of fires, Types of Extinguishing Media of Agent, Principles of Fire Extinguishing Methods Cooling, Starvation, Smothering, Retarding Chain Reaction, Stages of Fire, various Products of combustion.

Unit 2: **08**

- **National Building code-Part IV-Fire & Life safety:** Code & Standards in construction & Design of building. Classification of buildings based on occupancy and type of construction according to fire resistance as per NBC; Fire zone; General fire safety requirements applicable to all individual occupancies. General exit requirements as per NBC; Internal staircases; horizontal exits; fire tower; ramps; fire lifts; external fire escape ladders.

Unit 3: **07**

- **Specification of fire-fighting equipment:** Overview of Codes and Standards for active & passive fire protection system and materials.
- **Scaffolding:** Types, Parts, Hazards & Control Measures Scaffolding Code and Practice for construction of scaffolding.

Unit 4: **07**

- **International Code & Standards:** International code & standard for Hydraulic platform, Turntable ladder and other Rescue and fire-fighting devices. Code, Standard and specification concerning to safety of fire-fighting personnel i.e., Breathing Apparatus P.P.E., safety gears and other devices.

References:

1. National Building codes of India- Part IV (2016), Bureau of Indian standards
2. IS 3696-1: Safety code of scaffolds and ladders, Part 1: Scaffolds, BIS, Part 2-Ladders
3. IS 5896 (Part 3): Code of Practice for Selection, Operation, and Maintenance of Fire Fighting Appliances, Part 3: Turntable Ladder, BIS
4. IS 15105: Design and Installation of Fixed Automatic Sprinkler Fire Extinguishing Systems – Code of Practice, BIS
5. IS 6070: Code of practice for selection, operation and maintenance of trailer fire pumps, portable pumps, water tenders and motor fire engines, BIS
6. Sesha, P., Manual of Fire Safety
7. Jain, V.K., Fire Safety in Buildings

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BVFSM402

FIRE HYDRAULICS AND SUPPRESSION SYSTEM

Course Objective:

- To provide in depth knowledge of various fire suppression agents and extinguishing Mechanisms.
- To gain knowledge on basic components of Fire Suppression System and its application.
- To provide an overview of basic Principles of Fire Hydraulics and its calculation.

Course Outcomes:

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

- Know the active and passive fire protection design and precaution in building or other industries/ premises.
- Demonstrate the usage of various fire suppression system during any emergency
- Calculation of fire water demand for various hazardous installations.

Unit 1: **08**

- **Suppression Agents and Extinguishing Mechanisms:** Overview of suppression and extinguishment, Suppression agents/attributes, Portable Fire Extinguishers-Classifications of portable fire extinguishers, testing of portable fire extinguishers.
- **Standpipe and Hose Systems -** Basic components of standpipe and hose systems, Types of systems/ components/applications.

Unit 2: **08**

- **Water and Foam based Suppression System:** Basic components of water and foam-based suppression systems. Types of water and foam suppression systems/components and its applications.
- Attributes of system components, Hazard classifications/System design criteria, Spacing/location/ placement of discharge devices.
- **Carbon Dioxide Suppression System:** Basic components of Carbon dioxide-based suppression systems- Carbon dioxide based suppression system operation-Standard for Carbon dioxide based suppression systems-Types- Types Local application system- Total Flooding system Inspection, Testing and maintenance. Hazards of Carbon dioxide-based suppression system.

Unit 3: **07**

- **Dry Chemical and Wet Chemical Suppression System:** Basic components of Dry chemical & Wet chemical Suppression system- Fixed Dry chemical & Wet chemical Suppression system operation-Standards for Dry chemical & Wet chemical Suppression systemTypes- Local application system-Total Flooding system-Inspection, Testing and maintenance.

Unit 4: **07**

- **Hydraulics Systems: Overview of hydraulics-**Definition "hydraulics" in fire protection Engineering, basic Principles of Hydraulics and its calculation, Water Supply Analysis, types of water supply, Hydraulics of Water Supplies for Automatic Sprinkler Systems. Principles of water flow in a piping system and through an orifice, Concept of friction loss and determine friction loss. Fire water demand for calculation for process plants.

References:

1. Watts, J.M., Hall, J.R., SFPE Handbook of Fire Protection Engineering, National Fire Protection
2. Association Quincy, Massachusetts, (Society of Fire Protection Engineers, Boston), 3rd Edition, 2002.
3. Bromann, M., The Design and Layout of Fire Sprinkler Systems, Tyalor & Francis, CRC Press, 2nd Edition, 2001.
4. OISD-115 (Oil Industry Safety Directorate), (2002). Guidelines on Fire Fighting Equipment and Appliances in Petroleum Industry. <http://www.oisd.nic.in/oisd-std-115>.
5. OISD-116 (Oil Industry Safety Directorate), (2017). Fire Protection Facilities for Petroleum Refineries and Oil/Gas Processing Plants. <http://www.oisd.nic.in/oisd-std-116>.
6. OISD-117 (Oil Industry Safety Directorate), (2017). Fire Protection Facilities for Petroleum Depots, Terminals, Pipeline Installations & Lube oil installations. <http://www.oisd.nic.in/oisd-std117>.
7. OISD-142 (Oil Industry Safety Directorate), (1996). Inspection of fire-fighting equipments and systems. <http://www.oisd.nic.in/oisd-std-142>.
8. Lamalva, K.J., Hopkin, D., Structural Fire Engineering, Fire Protection Committee, American Society of Civil Engineers, 2018.
9. NFPA-13 (National Fire Protection Association), (2000). Standard for the Installation of Sprinkler Systems. <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-andstandards>
10. NFPA-15 (National Fire Protection Association), (2000). Standard for Water Spray Fixed Systems for Fire Protection. <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codesand-standards>

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BVFSM403
EXPLOSIONS AND INDUSTRIAL FIRE SAFETY

Course Objectives:

- To provide basic concepts of explosion hazards and its prevention measures.
- To provide in-depth knowledge of various processes involved in engineering industry and the associated hazards.

Course Outcomes:

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

- Identify hazards associated with various processes used in engineering industry.
- Formulate the methods of safe operations by effectively controlling the occupational health and safety hazards.
- Understand and apply safety requirements for safe material handling.

Unit 1: **08**

- **Introduction to Explosion Characteristics:** Explosion hazards & different case studies, Flammability limits and Theories-Lean limit and Rich limit, LEL & UEL measurement techniques and equipment, Minimum ignition energy, Relation between auto-ignition temperature and flash point, Effect of temperature and pressure on flash point, Classification of flammable materials, Vapour cloud tank explosion.

Unit 2: **08**

- **Explosion Prevention and Protection:** Explosion prevention techniques-Ventilation, Separation. Physical barriers. Alternative techniques, Preventing the formation of explosive atmosphere, Explosion protection systems - a. Protection techniques - Containment, Isolation, Suppression, Ventilation for explosion protection system, Explosion protection using inert gases, Flame arrestors and quenching distance.

Unit 3: **07**

- **Safety in Welding & Gas Cutting:** Gas welding and oxygen cutting, resistance welding, arc welding and cutting, common azards, personal protective equipment, training, safety precautions - 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 4: **07**

- **Principles of Machine Guarding:** Guarding during maintenance, Zero Mechanical State (ZMS), guarding of hazards-point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, fixed guard fencing.
- **Safety in cold forming and hot working of metals:** Cold work, power presses, point of operation safeguarding, auxiliary mechanisms, feeding and cutting mechanism, Hot work- safety in forging, hot rolling mill operation, hazards and control measures. Safety in gas furnace operation, foundry health hazards, work environment, material handling in foundries. Work permit system in cold and hot working areas.

References:

1. Nolan, D.P., Handbook of fire and Explosion Protection Engineering Principles for Oil, Gas, Chemical and Related Facilities, 3rd Edition, William Andrew, 2018.
2. Laute, S., Explosion Hazards in the Process Industries, UK ed. Edition, Scitus Academics LLC, 2016.
3. Eckhoff, R.E., Explosion Hazards in the Process Industries, Gulf Professional Publishing Company, 2nd Edition, 2016.
4. Tarafdar, N.K., Tarafdar, K.J., Industrial Safety Management, Assorted Editorial, 2018.
5. Poonia, M.P, Sharma, S.C., Industrial Safety and Maintenance Management, Khanna Book Publishing, 1st Edition, 2019.
6. Deshmukh, L.M., Industrial Safety Management, McGraw Hill Education, 2017.

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BVFSM404
MANAGEMENT AND RISK ASSESSMENT

Course Objective:

- To study the Managerial functions.
- To know about effective organizing.
- To analyze the special motivation techniques.

Unit 1: **08**

- **Introduction –** Management- Definition – Nature – Scope & Functions – Significance of Management – Technical Skills –Human skill – Conceptual skills Managerial roles – Interpersonal roles, informational roles, Decisional roles – Managerial functions- Planning – Organizing – Staffing – Leading – Controlling.

Unit 2: **08**

- **Planning –** nature & Purpose of planning – Objectives – Strategies – Policies – lanning premises – Decision making – Organizing – Nature and purpose of organizing – line / staff authority & decentralization – effective organizing – organization culture – staffing – general principles – importance and technique

Unit 3: **07**

- **Leading –** leadership – defining –element of leadership – leadership behaviour and styles – creativity & Innovation – motivation and motivators – special motivation techniques – communication – communication function in organization – communication process – barriers and breakdowns in communication – effective communication

Unit 4: **07**

- **Risk assessment –** Risk Assessment method – Hazard – Hazard symbols – Hazard Analysis – Hazard Ranking – Risk Management – Definitions – Functions of Risk Management – Safety Management – Need concept – Terms Related with safety Management – safety officer – supervisor – safety committees- Role of Trade union – Role of Trade union – Role of workers –safety and the law
- **Disaster Management –** Natural disaster- Cyclone – Tremor – storm – tropical cyclone – flood– Earthquake–landslide and avalanches – Nuclear and radiation accident – bio logical hazards.

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SEMESTER-05

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BVFSM501
FIRE DYNAMICS

Course Objectives:

- To understand about the combustion, chemistry, mass conversation, and its flame spread in the surrounding.
- To explain about the burning properties of materials, detail fire behaviour of materials, and building fire.

Course Outcomes:

Students will be able to

- Understand the fire dynamics in building or forest fire.
- Understand the basic of properties of burning of material and its chemical kinetics.
- Design the building as per fire safety requirements.

Unit 1: **08**

- **Combustion Fundamentals:** Chemical Thermodynamics and kinetics, Pyrolysis, ignition and combustion, conservation equations for mass, momentum, energy and species, turbulence, radiation.

Unit 2: **08**

- **Ignition of Flaming Combustion:** Introduction, flashpoint, dynamics of evaporation, evaporation rates, Clausius Clapeyron equations, estimate of ignition time components-Chemical time, mixing time, pyrolysis, ignition in thermally thin and thick solids, ignition properties of common materials, Heat flux in fire.

Unit 3: **07**

- **Fire Dynamics:** Flames and fire spread theory, buoyant plumes, and interactions with surfaces, smoke spread, turbulent diffusion flames, soot formation and radiation effects, toxic products; fire chemistry, nitrogen and halogen thermochemistry, numerical techniques.

Unit 4: **07**

- **Compartment Zone Fires:** Flashover, post-flashover, control, applications, numerical techniques, plume and ceiling jet **models.**
- **Heat Transfer in Fire:** Heat transfer concepts, Forms of heat transfer, conduction-Steady state condition, thermal penetration time, convection and radiation-hot gases and smoky gases, heat flux from flames, heat flux as an indication of damage.

References:

1. Drysdale, D.D., An Introduction to Fire Dynamics, Wiley, New York, 1999.
2. Lyons, J.W., Fire, Scientific American Books, New York.
3. Karlsson, B., and Quintiere, J.G., Enclosure Fire Dynamics, CRC Press.
4. Cox, G., Combustion Fundamentals of Fire, Academic Press, London, 1995.
5. Haessler, W.M., Fire: Fundamentals and Control, Marcel Dekker, 1988.
6. SFPE, Handbook of Fire Protection Engineering, NFPA, Quincy, Mass.
7. Quintiere, J.G., Principles of Fire Behavior, Delmar, 1985.

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BVFSM502
FIRE DETECTION SYSTEM AND ELECTRICAL SAFETY

Course Objectives:

- To provide an overview of Fire alarm & detection system used in various Industrial installations.
- To provide in-depth view of electrical safety at workplace as per national/international standards, codes and/or rules

Course Outcomes:

- Describe the phenomenon of electrical hazards associated causes, effects and prevention/ protection measures.
- Identify hazardous areas/locations in a given industrial site for selection, installation, operation and maintenance of electrical equipment.
- Explain the working principles and applications of various kinds of Fire alarm & detection system

Unit 1: **08**

- **Fire Detection System:** Introduction of detection devices, Alarm and detection system, Basic function of Fire alarm & detection system-Type of detectors- Smoke Detector-Smoke detector Classification- Heat detector – Heat detector Classification- Flame Detector- Flame Detector Classification-Method of selection- Working Principle-Advantages and disadvantages of various detection devices.

Unit 2: **08**

- **Introduction about Electrical Safety and Management:** Introduction – electrostatics, electromagnetism, stored energy, energy radiation and electromagnetic interference –Indian electricity act and rules statutory requirements from electrical inspectorate international standards on electrical safety – first aid-cardio pulmonary resuscitation (CPR).
- **Electrical Hazards:** Primary and secondary hazards - shocks, burns, scalds, falls - Human safety in the use of electricity- Classes of insulation-voltage classifications - current surges- over current and short circuit current-heating effects of current electrical causes of fire and explosion. Lightning hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth pit maintenance.

Unit 3: **07**

- **Electrical Protection Systems:** Fuse, circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage – voltage –safe distance from lines - overload and short circuit protection.
- **Earth leakage circuit breaker (ELCB) -** use of low voltage-electrical guards-Personal protective equipment. Role of environment in selection protection and interlock self-diagnostic features and fail-safe concepts-lock out and work permit system - safety in the use of portable tools-cabling and cable joints-preventive maintenance.

Unit 4: **07**

- **Hazardous Zones:** Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe equipment-their selection for different zones temperature classification-use of barriers and isolators.

References:

1. Rao, S., Electrical Safety Fire Safety Engineering and Safety Management, Khanna Publications,2nd Edition, 2012.
2. Fordham Cooper, W., Electrical Safety Engineering, Butterworth and Company, London, 2006.
3. Indian Electricity Act and Rules, Government of India.
4. Cadick, J., Electrical safety Handbook, Third Edition, McGraw Hill, 2006

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BVFSM503
SAFETY IN CONSTRUCTION

Course Objectives:

- To provide knowledge of various safety practices followed in Construction site
- To provide in-depth knowledge of various work carried in Construction site
- To familiarize the student applicable Statutory regulations, acts, Regulations

Course Outcomes:

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

- Understand the safety requirements in various construction operations and develop guidelines to ensure safety at construction site.
- Learn and apply the legal provisions with respect to the health and welfare of workers at construction site.
- Understand the safety requirements in material handling and equipment's and develop guidelines to ensure safety at construction site

Unit 1: **08**

- **Accidents Causes and Management Systems:** 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 accidents – The Building and other Construction workers (Regulation of Employment and conditions of Service) Central Rules, 1998, Contract document & contractual clauses Precontract activities, preconstruction meeting–Project HSE Plan-design aids for safe construction, permits to work, Personal protective equipment, Recording of accidents and safety measures, Education and training.

Unit 2: **08**

- **Hazards of Construction and Prevention:** Excavations, Trenches, Erection of structural framework, dismantling–tunneling–blasting, confined spaces–working on contaminated sites–work over water Safety during Demolition–Cordoning–Dismantling–Clearing debris Housekeeping – accidents due to poor housekeeping.

Unit 3: **07**

- **Fall Prevention and Fall Protection:** Fall prevention and fall protection - Fall protection in construction – OSHA requirement for working at heights, Different types of scaffolds – Design, safe erection, use and dismantling, scaffold inspection checklist, requirement for safe work platforms, stairways and ramps. Safe access and egress – safe use of ladders- Safety Harnesses, safety nets, fall arrestors, controlled access zones, safety monitoring systems – working on fragile roofs, Height pass –accident case studies.
- **Safety in Huge Structures:** Safety in typical civil structures – Dams-bridges-water Tanks Retaining Walls-Critical factors for failure-High rise buildings, Road works, and Power plant constructions

Unit 4: **07**

- **Construction Machinery:** 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, Inspection and Maintenance, Hand tools, Manual Material handling.

References:

1. Mishra, R.K., Construction Safety Paperback, 2013.
2. Herberle, D., Construction Safety Manual, McGraw-Hill, 1998.
3. Holt, A.S., Principles of Construction Safety Paperback, 2005.

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BVFSM504
UNIT OPERATIONS -I

Course Objectives:

- To study statics, kinematics and dynamics of fluids.
- To understand the characteristics associated with the fluid flow though pipeline systems.

Course Outcomes:

- Knowledge of fluid properties, stress, buoyancy and floatation.
- Classify fluid flow and flow pattern.
- Understand continuity and Bernoulli equations.
- Derive Darcy-Weisbach equation and Hagen-Poiseuille equation associated with pipe flow.
- Calculate friction factor from Moody diagram.
- Knowledge of minor & major losses and energy & hydraulic grade lines corresponding to pipe flow.
- Classify flow control valves and safety valves.

Unit 1: **08**

- **Fluid Statics:** Brief description of various fluid properties, Pressure at a point, Compressible and Incompressible fluid, Measurement of pressure, Manometry, Buoyancy, Archimedes' principle and stability

Unit 2: **08**

- **Fluid Kinematics:** Classification of fluid flows – viscous vs in viscid flow, internal vs external flow, compressible vs incompressible flow, laminar vs turbulent flow, natural vs forced flow, steady vs unsteady flow, uniform vs non-uniform flow; Flow patterns – timeline, streamline, path line, streamline

Unit 3: **07**

- Fluid Dynamics Fluid flow rate, Conservation of mass, Continuity equation, The Bernoulli's equation and its application
- **Pipe Flow:** Flow regimes in a pipe, Energy loss in pipes through Darcy Weisbach equation and Hagen-Poiseuille equation, Friction factor, Turbulent flow in pipes, Moody's Diagram

Unit 4: **07**

- **Pipeline Systems:** Basic of pipe network system, Minor losses in pipes, Energy and hydraulic grade line, Valves used in pipelines – Flow control valve, Check valve, Pressure relief valve/ Safety valves

References:

1. Elger, Donald F., Barbara A. LeBret, Clayton T. Crowe, and John A. Roberson. Engineering fluid mechanics. John Wiley & Sons, 2020.
2. Yunus, A. Cengel. Fluid Mechanics: Fundamentals and Applications (SI Units). Tata McGraw Hill Education Private Limited, 2010.
3. Fox, Robert W., Alan T. McDonald, and John W. Mitchell. Fox and McDonald's introduction to fluid mechanics. John Wiley & Sons, 2020.
4. R.K. Bansal, A textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications.

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SEMESTER-06

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BVFSM601
DISASTER MANAGEMENT AND EMERGENCY PREPAREDNESS

Course Objectives:

- To understand the basic concepts of disaster management and promote awareness of different types of disasters and their impacts.
- To impart knowledge to create appropriate planning, preparation and response for emergency treatment in disaster situation.

Course Outcomes:

- Understand the world-wide distribution of hazards and disasters and know the similarities and differences between natural and technological disasters.
- Gain preparedness skills that increase community effectiveness in responding to disaster.

Unit 1: **08**

- **Introduction: Disaster:** Definition, Factors and Significance; Difference between Hazard and Disaster;
- **Natural and Manmade Disasters:** Difference, Nature, Types and Magnitude, Disaster management act, 2005
- **Repercussions of Disasters and Hazards:**
  - » Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.
  - » **Natural Disasters:** Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches,
  - » **Man-made disaster:** Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit 2: **08**

- **Disaster Prone Areas in India:** Study of Seismic Z ones; 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 3: **07**

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

Unit 4: **07**

- **Risk Assessment:** Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

References:

1. Goel, S.L. Disaster Administration and Management Text and Case Studies, Deep & Deep Publication Pvt. Ltd., New Delhi, 2009.
2. Rai, N. Singh, A.K. Disaster Management in India: Pe respective, issues and strategies, New Royal book Company, 2007.
3. Pardeep, S. Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi,2001.

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BVFSM602

HAZARD IDENTIFICATION AND RISK ANALYSIS

Course Objectives:

- To understand the occurrence of hazards that are present in the workplace and its awareness.
- To learn the concepts of uncertainty, probability, and variability.
- To provide in-depth knowledge of safety in the design and operation of process plant.

Course Outcomes:

Students will be able to

- Carryout Risk assessment methods to various Industries and work practices and activity
- Create Bow tie diagram, ETA, FTA and FMEA
- Understand advantage and disadvantage of various risk analysis techniques

Unit 1: **08**

- **Hazard, Risk Issues and Hazard Assessment:** Introduction, hazard, hazard monitoring- risk acceptance levels, Risk estimation. Risk communication, Implementation and review, 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 2: **08**

- **Reliability and Fire Risk Assessment:** Component Life, Failure Rate, Estimating the parameters of a Distribution, System Reliability, Bayesian Methods.
- **Probability Models in Fire Protection Engineering:** Fault Tree & Event Tree Analysis, Human Error Analysis-Safety Review System-Hazard Warning, Methods-Hazard Warning Analysis- Plant Safety Audit. Introduction, Taxonomy of Methods for Fire Risk Assessment, Schedules, Insurance Rating, Dow's Fire and Explosion Index.

Unit 3: **07**

- **Statistics Analysis:** Introduction, Basic concept of statistical analysis, Key parameters of descriptive statistics, Correlation, Regression and Analysis of Variance.
- **Risk Control & Management Impact estimation:** Property, People, Man and Machine System, Job and Personal Risk Factors-Standards Selection and Training-Body Size and Posture-Body
- **Dimension (Static/Dynamic)-** Adjustment RangePenalties. -Guide Lines for Safe Design and PosturesEvaluation and Methods of Reducing Posture Strain.

Unit 4: **07**

- **Risk Analysis Simulation Software for Fire Protection:** Basic Concepts of Risk Analysis - Quantitative - Qualitative Methods - Hazard Assessment Systems - Hazard Operability Studies (HAZOP) - EFFECTS - Hazard Analysis (HAZAN) -Failure Mode and Effect Analysis (FMEA), Layer of Protection Analysis (LOPA)-Safety Integrity Level (SIL)-Basic concepts of Reliability- Software on Risk analysis, ALOHA and Bowtie Analysis.

References:

1. Watts, J.M., John R. Hall, J.R., Fire Risk Analysis, SFPE Handbook of Fire Protection Engineering, National Fire Protection Association Quincy, Massachusetts, (Society of Fire Protection Engineers, Boston), 3rd Edition, 2002.
2. Clement, G.A., Law of Fire Insurance, Nabu Press Primary Source Edition, 2013.
3. AIChE/CCPS, Guidelines for Hazard Evaluation Procedures, Centre for Chemical Process Safety, American Institute of Chemical Engineers, New York, 2nd Edition 1992.
4. Fire Protection Handbook (Volume 1&2), National Fire Protection Association (NFPA), 20th Edition, 2008.
5. Hasofer, A.M., Beck, V.R., Bennetts, I.D., Risk Analysis in Building Fire Safety Engineering, Butterworth-Heinemann, Elsevier Publication, 1st Edition, 2007.
6. Wells, G., Hazard Identification and Risk Assessment, Institution of Chemical Engineers, 1997.
7. Lees F.P. Loss Prevention in the Process Industries, Butterworths, London, 2nd Edition 1996.

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BVFSM603
SMOKE MANAGEMENT SYSTEM

Course Objectives:

- To understand about the smoke development, measurements and its toxic effects in the surrounding.
- To understand about the ventilation and its importance in building construction.
- To learn about the smoke control reduces the movement of smoke and air circulation in a large structural building.

Course Outcomes:

Students will be able to

- Learn the fundamentals of smoke control system and their importance to a facility of fire protection.
- Evaluate the smoke exhaust calculation and identify the toxic effects to humans.
- Identify the hazards and effects of personal exposure to occupants to airborne contaminants for eventual risk assessment.

Unit 1: **08**

- **Smoke Production in Fires:** Smoke measurements, Mass yields/mass fractions/molar yields/molar fractions. Smoke release rate/heat release rate. Visibility through smoke, influence of ventilation on smoke production.

Unit 2: **08**

- **Principles of Smoke Movement:** Air flow principles, Gas expansion, Buoyancy/stack effect/local heating.

Unit 3: **07**

- **Principles of Smoke Management:** Objectives of smoke management, Passive smoke management methods, Active/mechanically assisted smoke management methods. Opposed air flow Stairwell pressurization Zoned smoke control Smoke exhaust.

Unit 4: **07**

- **Smoke Management for Large Spaces:** Venting requirements, Natural ventilation through roof and wall openings, Mechanical smoke exhaust systems, Complex Smoke Management system.
- **Heating, Ventilation, and Air Conditioning (HVAC) Systems:** HVAC Engineering Equations for Daily Use, HVAC Engineering Fundamentals, Electrical Features of HVAC Systems, Sustainable HVAC Systems.

References:

1. Klote, J.H., Milke, J.A., Turnbull, P.G., Kashef, A., Ferreira, M.J., Handbook of Smoke Control Engineering, Amer Society of Heating, Atlanta, 2012.
2. Klote, J.H., Milke, J.A., Principles of Smoke Management, American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc.1791 Tullie Circle, N.E. Atlanta, 1992.
3. Schifiliti, R.P., Design of Detection Systems, SFPE Handbook of Fire Protection Engineering, 3rd Edition, National Fire Protection Association Quincy, Massachusetts, (Society of Fire Protection Engineers, Boston), 2002, Ch. 3-1.
4. Shapiro, J., Standpipe and Hose Systems, Fire Protection Handbook, 17th Edition, ed A.E. Cote (NFPA), Ch. 5-14, 1991.
5. Haines, R.W., Myers, M.E., HVAC Systems Design Handbook, 5th Edition, McGraw Hill, 2009.
6. Khalil, D.E.E, Khalil, E.E. Sprinklers and Smoke Management in Enclosures, 1st Edition CRC Press, 2020.

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BVFSM604
UNIT OPERATIONS -II

Course Objectives:

- To understand the fundamentals of heat transfer mechanisms in fluids and solids and their applications in various heat transfer equipment in process industries.

Course Outcomes:

Students completing the course will be able to:

- Understand basic laws associated with conduction, convection and radiation and its applications.
- Analyze problems involving steady heat conduction in simple geometries.
- Understand the concept of convective heat transfer and to analyze the problems involving heat transfer coefficients for natural and forced convection
- Analyze heat exchanger performance using LMTD and use it for parallel or counter flow
- Recognizer various type of heat exchanger working principle, and basic geometries of heat exchanger.
- Determine the overall heat transfer coefficient for a heat exchanger.
- Understand the concept of boiling and condenser.
- Analyze the performance of evaporator.

Unit 1: **08**

- **Introduction:** Heat and Modes of heat transfer: Conduction, Convection, Radiation, Concept of steady state and unsteady state heat transfer, Analogy between flow of heat and electricity.
- **Conduction:** Thermal conductivity, Fourier's law of heat conduction, Steady state equation, Heat flow equation for composite walls, Composite cylinders, Spheres, Insulation and insulating materials, Critical insulation thickness.

Unit 2: **08**

- **Convection:** Nature of heat convection, Dimensional analysis and significance of various dimensional groups, Forced convection (No derivation), Free convection (No derivation)
- **Thermal Radiation:** Nature of thermal radiation, Absorption, Transmission, Reflection and Emission of radiation, Emissive power of black body, Plank's distribution, Total emissive power, Stefan-Boltzman law, Emissivity, Kirchoff's law, Black body, Wien's displacement law.

Unit 3: **07**

- **Heat Exchangers:** Introduction, Types of Heat Exchangers, Overall Heat Transfer Coefficient, Construction and Description of Various Types of Heat Exchangers, Logarithmic Mean Temperature Difference, LMTD for Parallel and Counter Current Heat Exchangers.

Unit 4: **07**

- **Boiling, Condensation and Evaporation:** Interface, Bubble and Film boiling, Boiling regime, Concept of condensation, Types of condensation: Drop wise and Film wise condensation, Evaporation: Introduction, Liquid characteristics, types of evaporator, economy & capacity, method of feeding, examples based on single effect evaporator.

References:

1. J. P. Holman, Heat Transfer, McGraw - Hill.
2. B. K. Dutta, Heat Transfer, Prentice Hall of India.
3. D.Q. Kern, Process Heat Transfer, Tata McGraw - Hill.
4. W. L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, McGraw-Hill.

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