COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

B. TECH DEGREE PROGRAMME IN SAFETY AND FIRE ENGINEERING

(2019 Admissions)

SCHEME OF EXAMINATIONS AND SYLLABUS

I to VIII SEMESTERS

B.TECH DEGREE PROGRAMME IN SAFETY AND FIRE ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1. Graduates will compete on a global platform to pursue their professional career in Safety and Fire Engineering and allied disciplines.
PEO2. Graduates will pursue higher education and/or engage in continuous up gradation of their professional skills.
PEO3.Graduates will communicate effectively and will demonstrate professional behaviour while working in diverse teams.
PEO4. Graduates will demonstrate high regard for human rights, respect values in diverse cultures, and have concern for society and environment

PROGRAM OUTCOMES (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Analyse and assess fire safety of buildings and industries to design and specify fire protection systems.
PSO 2: Assess hazards and risks in process and manufacturing industries and devise remedial measures and safety management systems.
PSO 3: Assess the occupational health and environmental issues associated with industrial and other activities to design control measures with traditional and modern computational tools based on codes and statutes.

B.TECH DEGREE PROGRAMME IN SAFETY & FIRE ENGINEERING

Scheme of Examinations (2019 admissions)

SEMESTER I [Stream A]

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/ Wk	C	Marks		Total
						CA	SEE	
19-200-0101A	Computer Programming	3	1	0	3	40	60	100
19-200-0102A	Engineering Chemistry	3	1	0	3	40	60	100
19-200-0103A	Engineering Graphics	2	1	3	3	40	60	100
19-200-0104A	Basic Electrical Engineering	3	0	0	3	40	60	100
19-200-0105A	Basic Electronics Engineering	3	0	0	3	40	60	100
19-200-0106A	Environmental Studies	3	1	0	3	40	60	100
19-200-0107A	Electrical Engineering Workshop	0	0	3	1	25	25	50
19-200-0108A	Computer Programming Laboratory	0	0	3	1	25	25	50
	TOTAL	**17**	**4**	**9**	**20**			

CA – Continuous Assessment, SEE – Semester End Examination

***Stream A*:** Civil Engineering, Electrical and Electronics Engineering, Mechanical Engineering and Safety and Fire Engineering.

SEMESTER II [Stream A]

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/ Wk	C	Marks		Total
						CA	SEE	
19-200-0201A	Calculus	3	1	0	3	40	60	100
19-200-0202A	Engineering Physics	3	1	0	3	40	60	100
19-200-0203A	Engineering Mechanics	4	1	0	3	40	60	100
19-200-0204A	Basic Civil Engineering	3	0	0	3	40	60	100
19-200-0205A	Basic Mechanical Engineering	3	0	0	3	40	60	100
19-200-0206A	Soft Skills Development	2	1	0	2	50	-	50
19-200-0207A	Civil Engineering Workshop	0	0	3	1	25	25	50
19-200-0208A	Mechanical Engineering Workshop	0	0	3	1	25	25	50
19-200-0209A	Language Lab	0	0	1	1	25	25	50
19-200-0210A	NSS/Nature conservation Activities	0	0	1	0	-	-	-
	TOTAL	**18**	**4**	**8**	**20**			

SEMESTER III

Code No.	Subject	L Hrs/ Wk	T Hrs/ Wk	P Hrs/ Wk	C	CA	SEE	Total
19-200-0301	Linear Algebra & Transform Techniques*	3	1	0	3	40	60	100
19-206-0302	Chemical Process Principles	3	1	0	3	40	60	100
19-206-0303	Engineering Fluid Mechanics and Machinery	3	1	0	3	40	60	100
19-206-0304	Fire Engineering Fundamentals	3	1	0	3	40	60	100
19-206-0305	Elements of Machine Drawing	1	0	3	3	40	60	100
19-206-0306	Principles of Safety Management	3	1	0	3	40	60	100
19-206-0307	Fluid Mechanics and Machinery Laboratory	0	0	3	1	25	25	50
19-206-0308	Safety Engineering Laboratory	0	0	3	1	25	25	50
	TOTAL	**16**	**5**	**9**	**20**			

***Common for CE/CS/EC/EE/IT/ME/SE**

SEMESTER IV

Code No.	Subject	L Hrs/ Wk	T Hrs/ Wk	P Hrs/ Wk	C	CA	SEE	Total
19-200-0401	Complex Variables and Partial Differential Equations*	3	1	0	3	40	60	100
19-206-0402	Heat and Mass Transfer Operations	3	1	0	3	40	60	100
19-206-0403	Strength of Materials	3	1	0	3	40	60	100
19-206-0404	Planning and Design of Fire Protection Systems	3	1	0	3	40	60	100
19-206-0405	Electrical Technology and Safety	3	1	0	3	40	60	100
19-206-0406	Occupational Health and First Aid	3	1	0	3	40	60	100
19-200-0407	Universal Human Values*	3	0	0	3	50	-	50
19-206-0408	Strength of Materials Laboratory	0	0	3	1	25	25	50
19-206-0409	Electrical Technology Laboratory	0	0	3	1	25	25	50
	TOTAL	**21**	**6**	**6**	**23**			

*** Common for CE/CS/EC/EE/IT/ME/SE**

SEMESTER V

Code No.	Subject	L Hrs/ Wk	T Hrs/ Wk	P Hrs/ Wk	C	CA	SEE	Total
19-200-0501	Numerical and Statistical Methods*	3	1	0	3	40	60	100
19-206-0502	Chemical Technology and Reaction Engineering	3	1	0	3	40	60	100
19-206-0503	Principles of Engineering Design	3	1	0	3	40	60	100
19-206-0504	Structural Fire Safety	3	1	0	3	40	60	100
19-206-0505	Manufacturing Processes	3	1	0	3	40	60	100
19-206-05**	Professional Elective - I	3	1	0	3	40	60	100
19-206-0510	Chemical Engineering Laboratory	0	0	3	1	25	25	50
19-206-0511	Fire Safety Training	0	0	3	1	25	25	50
	TOTAL	**18**	**6**	**6**	**20**			

*** Common for CE/CS/EC/EE/IT/ME/SE**

Professional Elective – I

19-206-0506 Disaster Management
19-206-0507 (IE) Aviation Safety and Safety of Space Missions
19-206-0508 Safety in Fireworks Industry
19-206-0509 Introduction to Process Plant Security and Information Security

SEMESTER VI

Code No.	Subject	L Hrs/ Wk	T Hrs/ Wk	P Hrs/ Wk	C	CA	SEE	Total
19-206-0601	Legal Aspects of HSE	3	1	0	3	40	60	100
19-206-0602	Process Instrumentation and Control	3	1	0	3	40	60	100
19-206-0603	Chemical Process Safety	3	1	0	3	40	60	100
19-206-0604	Life Safety in Building Fire	3	1	0	3	40	60	100
19-206-0605	Environmental Engineering and Management	3	1	0	3	40	60	100
19-206-06**	Professional Elective II	3	1	0	3	40	60	100
19-206-0610	Machine Shop	0	0	3	1	25	25	50
19-206-0611	Computational Laboratory	0	0	3	1	25	25	50
	TOTAL	**18**	**6**	**6**	**20**			

****Professional Elective II**
19-206-0606 Power Plant Engineering
19-206-0607(IE) Safety in Petroleum and Petrochemical Industries
19-206-0608 Food and Biosafety
19-206-0609 Fault Detection and Diagnosis

SEMESTER VII

Code No.	Subject	L Hrs/ Wk	T Hrs/ Wk	P Hrs/ Wk	C	CA	SEE	Total
19-206-0701	Hazard Identification and Risk Assessment	3	1	0	3	40	60	100
19-206-0702	Transportation Systems and Safety	3	1	0	3	40	60	100
19-206-0703	Safety in Construction	3	1	0	3	40	60	100
19-206-07**	Professional Elective III	3	1	0	3	40	60	100
19-206-07***	Open Elective I	3	0	0	3	40	60	100
19- 206 -0712	Fire Engineering Laboratory	0	0	3	1	25	25	50
19-206-0713	Industrial Hygiene Laboratory	0	0	3	1	25	25	50
19-206-0714	Entrepreneurship Development	0	0	2	1	50	-	50
19-206-0715	Project Phase – I	0	0	3	1	50	-	50
19-206-0716	Industrial Internship	0	0	-	1	50	-	50
	TOTAL	**15**	**4**	**11**	**20**			

****Professional Elective III**
19-206-0704 Principles of Industrial Management
19-206-0705(IE) HSE Aspects of Fertiliser Industry
19-206-0706 Automobile Engineering and Safety
19-206-0707 Reliability Engineering

*****Open Elective I**
19-206-0708 Industrial Psychology
19-206-0709 Entrepreneurship and Small Business Enterprises
19-206-0710 Science and Technology of Nano Materials
19-206-0711 Energy Management and Conservation

SEMESTER VIII

Code No.	Subject	L Hrs/ Wk	T Hrs/ Wk	P Hrs/ Wk	C	CA	SEE	Total
19-206-0801	Hazard Control in Manufacturing	3	1	0	3	40	60	100
19-206-08**	Professional Elective IV	3	1	0	3	40	60	100
19-206-08**	Professional Elective V	3	1	0	3	40	60	100
19-206-08**	Open Elective II	3	0	0	3	40	60	100
19-206-0815	Seminar	0	0	3	1	50	-	50
19-206-0816	Project Phase II	0	0	12	6	200	-	200
19-206-0817	Comprehensive Viva Voce	0	0	0	1	-	50	50
	TOTAL	**12**	**3**	**15**	**20**			

****Professional Elective IV**
19-206-0802 Total Quality Management
19-206-0803 Human Factors Engineering
19-206-0804 Computational Fluid Dynamics
19-206-0805 Intellectual Property Rights

****Professional Elective V**
19-206-0806 Advanced Safety Engineering and Management
19-206-0807 Fluid Power Safety
19-206-0808 Explosives Technology and Safety
19-206-0809 Introductory Design of Structures

****Open Elective II**
19-206-0810 History and Philosophy of Science
19-206-0811 Non-destructive Testing Methods
19-206-0812 Environmental Economics
19-206-0813 Biology for Engineers
19-200-0814 Constitutional Law

Industry based Electives
Industry based Electives are offered in 5th, 6th and 7th Semesters and are listed among the Professional Electives with notation (IE) along with the subject code. A student should opt for at least one Industry based elective during the B.Tech. programme.

Open Electives
Open Electives are offered in 7th and 8th Semesters. A student should opt for at least one Open Elective offered by any Division other than their branch of study.

Industrial Internship of a minimum duration of 2 weeks must be completed after 4th Semester and before commencement of 7th Semester. The evaluation of internship will be conducted along with Project Phase I.

Evaluation Pattern for Theory and Practical courses.

Theory courses
Type of Questions for Semester End Examination (SEE)

PART - A (8 x 3 = 24 marks)
Question No. I (a) to (h) – Eight short answer questions of 3 marks each with two questions from each of the four modules.

PART - B (4 x 12 = 48 marks)
Question nos. II, III with sub sections (a), (b)----------12 marks each with option to answer either II or III from Module I.
Question nos. IV, V with sub sections (a), (b)----------12 marks each with option to answer either IV or V from Module II.
Question nos. VI, VII with sub sections (a), (b)----------12 marks each with option to answer either VI or VII from Module III.
Question nos. VIII, IX with sub sections (a), (b)----------12 marks each with option to answer either VIII or IX from Module IV.

Maximum marks that can be awarded for the Semester End Examination (SEE) will be only 60, even though the questions are for 72 marks.

Practical courses
50% marks is earmarked for Continuous Assessment and 50% marks for Semester End Examination. The Semester End Examination is to be conducted by a minimum of two examiners including one not below the rank of an Associate Professor.

Pass Requirements
A candidate has to obtain a minimum of 50% marks for Continuous Assessment and Semester End Examination put together with a minimum of 40% marks in the Semester End Examination for a pass in the theory and laboratory courses.

In the case of theory / laboratory / other courses having only continuous assessment, a candidate has to obtain a minimum of 50% marks in Continuous Assessment for a pass.

19-200-0101A/19-200-0201B COMPUTER PROGRAMMING

Course Outcomes:

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

1. Identify main components of a computer system and explain its working.
2. Develop flowchart and algorithms for computational problems.
3. Write the syntax of various constructs of C language.
4. Build efficient programs by choosing appropriate decision making statements, loops and data structures.
5. Illustrate simple search and sort algorithms.
6. Demonstrate how to perform I/O operations in files for solving real world problems.
7. Design modular programs using functions for larger problems.

Module I

Basics of Computer and Information Technology:

Digital Computer System (CPU, Memory, I/O devices)- Working of a digital computer-Hardware and Software : Definition - Categories of Software, Application of Computers.

Problem Solving Methodology:

Problem statement, Analysis, Design a solution, Implement/Coding the solution, Test the solution, Design tools (Algorithm, Flow-chart, Pseudo-code)- Develop algorithms for simple problems.

Programming Languages:

Types of programming languages-Compiler–Interpreter-Linker–Loader–Execution of program.

Module II

Basics of C:

Character set-Identifier- Keywords- Constants –Data Types- Variables and declaration –Operators and Expressions – Operator precedence and associativity – Expression Evaluation (Simple Examples) - Input and output functions – Simple computational problems involving the above constructs.

Control Statements:

Selection, Conditional operator, Iteration (for, while, do-while), Branching (switch, break, continue, goto), Nesting of control statements- Problems using control statements.

Module III

Arrays and Strings:

1D and 2D arrays –Searching (Linear and Binary) - Sorting (Bubble, Selection) – Matrix manipulation programs – Strings and basic operations on strings – Strings functions -Programs on string manipulation.

Functions:

Definition – Calling – Declaration – Parameter Passing (by value and by reference) – Recursion – Programs based on functions.

User defined data types:

Structure – Union - Enumerated data type - Programs involving structure and union.

Module IV

Pointers:

Declaration, Initialization – Operations on pointers- Pointers and arrays – Pointers and Structures-Command line arguments-Dynamic memory allocation — Programs involving the above concepts.

Files:

File concept – File pointer – File handling operations (open, close, read, write etc) on sequential and random access files. Programs on file manipulations using fgetc(), fgets(),fseek().

References:

1. Pradip Dey and Manas Ghosh, Computer Fundamentals and Programming, Second Edition, Oxford University Press, (2013).
2. Byron Gottfried, Programming with C, Second edition, Tata McGraw-Hill, (2006).
3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Second Edition, Pearson Education, (2001).
4. R.G. Dromey, How to solve it by Computer, Pearson Education, (2008).
5. Kanetkar Y, Let Us C, BPB Publications, (2007).

19-200-0102A/19-200-0202B ENGINEERING CHEMISTRY

Course Outcomes:

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

1. Interpret the basic principles and concepts of quantum mechanics
2. account for how spectroscopic methods can be used to determine molecular structures, with focus on the identification of characteristic groups in polyatomic molecules
3. Apply the laws of thermodynamics to engineering systems.
4. Explain the chemistry of a few important engineering materials and their industrial applications.

Module I

Quantum Chemistry: Schrodinger equation. Derivation from classical wave equation. Operator form of the equation. Application of Schrodinger equation to 1-D box solutions. Significance of wave functions, probability and energy. Application of 1-D box solutions to conjugated molecules.

Forms of hydrogen atom wave functions and the plots of these functions to explore their spatial variations.

Energy level diagrams of diatomic molecules, Pi-molecular orbitals of butadiene, and benzene and aromaticity.

Module II

Spectroscopy: Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine.

Vibrational and rotational spectroscopy of diatomic molecules. Applications.

Nuclear magnetic resonance and magnetic resonance imaging.

Surface characterisation techniques. Diffraction and scattering.

Module III

Chemical Thermodynamics: Fundamentals. First law of thermodynamics. Molecular interpretation of internal energy, enthalpy and entropy. Heat of reaction. Kirchoff's equations. Dependence on pressure and temperature. Gibbs-Helmholtz equation. Free energy changes and equilibrium constant. Chemical potential and fugacity. Thermodynamics of biochemical reactions.

Phase Rule: Terms involved in phase rule and examples, Application of phase rule to one component water system, Application of phase rule to two-component systems. (Simple eutectic systems).

Module IV

Engineering materials:

Polymers- Classifications- Mechanism of polymerisation (Addition, free radical, cationic, anionic and coordination polymerisation)- Thermoplastics and thermosetting plastics-Compounding of plastics-Moulding techniques of plastics (Compression, Injection, Transfer and Extrusion moulding)-Preparation, properties and uses of PVC, PVA, PET, Nylon- Silicon polymers-Biodegradable plastics. Elastomers- structure of natural rubber- vulcanisation- synthetic rubbers (Buna-S, Butyl rubber and Neoprene).

Lubricants- Introduction-Mechanism of lubrication- solid and liquid lubricants- Properties of lubricants-Viscosity index- flash and fire point- cloud and pour point- aniline value.
Refractories: Classification – Properties of refractories.
Cement- Manufacture of Portland cement- Theory of setting and hardening of cement.

References:

1. B. H. Mahan and R. J. Meyers University Chemistry, 4th Edition, Pearson publishers. (2009).
2. Peter W. Atkins, Julio de Paula, and James Keele. Physical Chemistry, 11th Edition, Oxford publishers. (2018).
3. M. J. Sienko and R. A. Plane. Chemistry: Principles and Applications, 3rd Edition, McGraw-Hill publishers.(1980).
4. C. N. Banwell. Fundamentals of Molecular Spectroscopy, 5th Edition, McGraw-Hill publishers.(2013).
5. B.L. Tembe, M.S. Krishnan and Kamaluddin. Engineering Chemistry (NPTEL Web Course)
6. Shashi Chawla. A Text book of Engineering Chemistry. Dhanpat Rai & Co, New Delhi.(2013).

19-200-0103A/19-200-0203B ENGINEERING GRAPHICS

Course Outcomes:

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

1. Prepare drawings as per Indian standards
2. Produce orthographic projection of straight lines and planes.
3. Draw orthographic projection of solids.
4. Understand development of surface of different geometric shapes
5. Construct isometric scale, isometric projections and views.

Module I

Introduction to engineering graphics. Drawing instruments and their use. Familiarisation with current Indian Standard Code of Practice for general engineering drawing.

Scales- plain scale, Vernier scale, diagonal scale.

Conic sections- Construction of ellipse, parabola, hyperbola - construction of cycloid, involute, Archimedian spiral and logarithmic spiral- drawing tangents and normal to these curves.

Module II

Introduction to orthographic projections- plane of projection- principles of first angle and third angle projections, projection of points in different quadrants.

Orthographic projection of straight lines parallel to one plane and inclined to the other plane- straight lines inclined to both the planes- true length and inclination of lines with reference planes- traces of lines.

Projection of plane laminae of geometrical shapes in oblique positions.

Module III

Projection of polyhedra and solids of revolution- frustum, projection of solids with axis parallel to one plane and parallel or perpendicular to other plane- projection of solids with axis inclined to both the planes- projection of solids on auxiliary planes.

Section of solids by planes inclined to horizontal or vertical planes- true shape of sections.

Module IV

Development of surface of cubes, prisms, cylinders, pyramids and cones

Intersection of surfaces- methods of determining lines of intersection - intersection of prism in prism and cylinder in cylinder.

Module V

Introduction to isometric projection- isometric scales, isometric views- isometric projections of prisms, pyramids, cylinders, cones and spheres.

Introduction to perspective projections: visual ray method and vanishing point method- perspective of circles- perspective views of prisms and pyramids.

References:

1. John, K.C. Engineering graphics. PHI Learning, New Delhi.(2013)
2. Bhat, N.D. Elementary engineering drawing. (Forty ninth edition). Charotar Publishing House, Anand.(2010)
3. Gill P.S. Geometric drawing. B.D Kataria &Sons, Ludhiana.(2012)

<u>Type of questions for Semester End Examination</u>

Two questions of 12 marks each from Module I with option to answer any one. (1 x 12 = 12).

Two questions of 15 marks each from Module II, Module III, Module IV and Module V with option to answer any one question from each module. (4 x 15 = 60).

19-200-0104A/19-200-0204B BASIC ELECTRICAL ENGINEERING

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

1. Analyse and solve electric circuits
2. Understand the principles of electromagnetic induction and identify meters for measuring electrical quantities
3. Recognise the basic elements and phases in AC circuits
4. Identify the type of electrical machine for a given application

Module I
Basic principles of Electric circuits: Review of Ohm's law - Definition of Resistance, Current, Voltage and Power - Series and Parallel circuits- Constant voltage source and Constant current source.
Network Theorems: Kirchhoff's laws- Network analysis by Maxwell's circulation currents - Superposition theorem -Thevenin's theorem - Norton's theorem - simple illustrative problems on network theorems.
Review of electrostatics - Coulomb's Law- Electric field strength and electric flux density, Capacitance.

Module II
Review of electromagnetic induction -Faraday's Law- Lenz's Law - Mutually induced emf.
Magnetic circuits - Magnetic field of a coil - Ampere turns calculation - Magnetic flux - Flux density - Field strength.
Measuring instruments: Working principle of galvanometer, Ammeter, Voltmeter, Watt meter & Energy Meter (elementary concepts).

Module III
AC Fundamentals: Sinusoidal Alternating Waveforms - Sinusoidal AC Voltage characteristics and definitions — General representation of voltage or current – Phase Relations – Average value – Effective (Root mean square) value.
The Basic Elements and Phasors: Response of basic R, L and C elements to a sinusoidal voltage or current –Phasor diagrams, Frequency response of the basic elements – Average power and power factor – Complex representation of vectors (Rectangular & polar forms)
Series and Parallel ac Circuits: Series & parallel impedances and admittances, Analysis of RL, RC & RLC circuits, Resonance in series and parallel circuits- Variation of impedance and admittance in series and parallel resonant circuits. Power in ac circuits: active, reactive & apparent power.
Introduction to 3 phase Systems: Star& Delta connection, Power in three phase circuits

Module IV
Electrical Machines: Principle of operation, Types and applications of DC machines, Transformers and Induction Machines. (Only an elementary qualitative treatment is envisaged.)
Elementary Concepts of Generation, Transmission, and Distribution: Conventional sources of electrical energy: Hydro, Thermal, Nuclear and Diesel power station, Non-conventional Sources: Solar energy, wind energy & energy from oceans, Various levels of power transmission, introduction to primary and secondary distribution

References:

1. Robert L. Boylestad. Introductory circuit analysis. (Twelfth edition). Pearson Education, New Delhi. (2012)
2. Cotton, H. Electrical technology. (Seventh edition). CBS Publishers and Distributors, New Delhi. (2005)
3. Leonard S. Bobrow. Fundamentals of electrical engineering. Oxford University Press, New Delhi.(1996).
4. Rajendra Prasad. Fundamentals of electrical engineering. (Second edition). PHI Learning, New Delhi.(2009)
5. Edward Hughes. Electrical technology. Addison Wesley Longman, Boston. (1995).

19-200-0105A/19-200-0205B BASIC ELECTRONICS ENGINEERING

Course Outcomes:

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

1. Develop an understanding of the behaviour of semiconductor junctions, diodes and BJTs
2. Familiarize with the applications of Diodes in rectification and regulation
3. Relate the role of BJTs in amplification and switching
4. Identify various measuring instruments and their functions
5. Gain knowledge on the fabrication of semiconductor devices and ICs

Module I:

Basic Semiconductor and PN Junction Theory: Atomic Theory, Conduction in Solids, Conductors, Semiconductors and Insulators, n-Type and p-Type semiconductors, Semiconductor conductivity
The p-n Junction, Biased Junctions. Junction Currents and Voltages

Module II:

Semiconductor Diodes and Applications: PN Junction Diode, Characteristics and parameters, Diode Approximations, DC Load Line Analysis, Temperature Effects, Diode AC Models, Diode Specifications, Diode Testing, Zener Diodes
Half wave rectification, Full wave rectification, RC and LC Filters, Shunt Voltage Regulators, Power supply - performance and Testing
Optoelectronic Devices-LED, LCD, Seven segment displays

Module III:

Bipolar Junction Transistors and Electronic measuring instruments: BJT Operation, BJT voltages and currents, BJT Amplification and Switching, Common Base, Common Emitter and Common Collector Characteristics, Transistor Testing
Electronic measuring instruments – Power Supply, Function Generator, CRO, Multimeter.

Module IV:

Fabrication of Semiconductor Devices and ICs: Processing of Semiconductor materials, Diode Fabrication and Packaging, Transistor construction and Performance, Transistor Fabrication, Integrated Circuits, IC components and circuits, Transistor and IC packaging, Transistor Data sheets, Power measurement in dB

References:

1. David A Bell, Electronic Devices and Circuits Oxford Higher Education, 5th Edition, (2017).

2. NN Bhargava, DC Kulshreshtha, SC Gupta, Basic Electronics and Linear circuits, Tata McGrawHill Publishing Company, 2nd Edition, (2013).

19-200-0106A/19-200-0206B ENVIRONMENTAL STUDIES

Course Outcomes:

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

1. Identify the natural resources and suitable methods for conservation and sustainable development
2. Realise the importance of eco system and biodiversity for maintaining ecological balance
3. Identify environmental pollutants and abatement mechanisms
4. Understand environmental problems arising due to developmental activities and population growth

Module I

Multidisciplinary nature of environmental studies. Definition, scope and importance, need for public awareness.

Natural Resources: Renewable and non-renewable resources: Natural resources and associated problems. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.

Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Module II

Ecosystems: Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystems: - Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its conservation: Introduction – Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. Inida as a mega-diversity nation. Hot-sports of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Module III

Environmental Pollution: Definition. Cause, effects and control measures of: - a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies.

Diaster management: floods, earthquake, cyclone and landslides.

Environmental legislation: Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation.

Module IV

Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Wasteland reclamation. Consumerism and waste products.

Social Issues and the Environment: From Unsustainable to Sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case Studies. Public awareness.

Human Population and the Environment: Population growth, variation among nations. Population explosion – Family Welfare Programme. Environment and human health. Human Rights. Value Education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Case Studies.

Field work: Visit to a local area to document environmental assets river/ forest/grassland/hill/mountains. Visit to a local polluted site-Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems-pond, river, hill slopes, etc.

References:

1. Rajagopalan, R. Environmental studies: From crisis to cure. Oxford University Press, New Delhi. (2005).
2. Erach Bharucha. Textbook of environmental studies and ethics. Universities Press (India), Hyderabad. (2005).
3. Jayashree A. Parikh. Balsaraf, V.M. and Dwivedi, P.B. Environmental studies. Ane Books Pvt. Ltd, New Delhi. (2010)
4. Anindita Basak. Environmental studies, Pearson, New Delhi. (2009).
5. Misra, S.P. (2011). Essential environmental studies. (Third edition). Ane Books Pvt. Ltd., New Delhi. (2011).
6. Benny Joseph. Environmental science & engineering, Tata McGraw Hill Education Pvt. Ltd., New Delhi. (2010).

19-200-0107A/19-200-0207B ELECTRICAL ENGINEERING WORKSHOP

Course Outcomes:

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

1. Apply basic electrical engineering knowledge for house wiring practice

Experiments:

1. One lamp controlled by one switch
2. Series and parallel connections of lamps.
3. Stair case wiring.
4. Hospital Wiring.
5. Godown wiring.
6. Fluorescent lamp.
7. Connection of plug socket.
8. Different kinds of joints.
9. Winding of transformers.
10. Soldering practice.
11. Familiarisation of CRO.
12. Single Phase Distribution Board Wiring.

19-200-0108A/19-200-0208B COMPUTER PROGRAMMING LABORATORY

Course Outcomes:

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

1. Solve problems efficiently by choosing loops and decision making statements in C programming.
2. Implement different operations on arrays.
3. Solve problems using functions and recursion.
4. Design and implement C programs using the concepts of structure, pointers and files.

Cycle I

Application Packages:

Text Editor

1. To create a word document like an advertisement.

Spread Sheet

2. To create a spread sheet to analyse the marks of the students of a class and also to create appropriate charts.

Presentation Software

3. To create a presentation for the department using Power Point.

C Programming Basics:

4. To write a program to calculate and display areas of rectangle and triangle.

Decision Making:

5. To write a program for electricity bill preparation.
6. To write a program to find the roots of a quadratic equation.
7. To write a simple menu driven calculator program using switch statement.
8. To write a program to find the sum of digits of a given number.

Cycle II

Looping:

9. To write a program to print all the prime numbers of a given range.
10. To write a program to print the sine and cosine series.
11. To write a program to print Pascal's triangle.

Arrays:

12. To write a program to print the sum and average of elements in an array.
13. To write a program to sort the given numbers using bubble sort.
14. To write a program to perform Matrix addition and matrix multiplication.

String:

15. To write a program to perform string manipulation functions like string concatenations, comparison, find the length and string copy without using library functions.
16. To write a program to arrange names in alphabetical order.

Cycle III

Functions:

17. To write a C program to calculate the mean, variance and standard deviation using functions.
18. To write a C program to perform sequential and binary search using functions.

Recursion:

19. To write a program to print the Fibonacci series using recursive function.
20. To write a program to print the factorial of the given number using recursive function.

Structure:

21. To print the mark sheet of n students using structures.

Pointers:

22. To write a program using pointers to access the elements of an array and count the number of occurrences of the given number in the array.

Files:

23. To write a program to count the number of characters,lines in a file.

References:

1. Pradip Dey and Manas Ghosh, Computer Fundamentals and Programming in C, Second Edition, Oxford University Press, (2013).
2. Smarajit Ghosh, All of C, PHI Learning Pvt. Ltd, (2009).
3. Byron Gottfried, Programming with C, 2 nd edition, Tata McGraw-Hill, (2006).
4. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Second Edition, Pearson Education, (2001).
5. Sukhendu Dey, Debobrata Dutta, Complete Knowledge in C, Narosa PublishingHouse, New Delhi, (2009).

19-200-0101B/ 12-200-0201A CALCULUS

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

1. Recall the methods of differentiation and integration.
2. Solve ordinary differential equations and linear differential equations of higher orders with constant coefficient and apply them in engineering problems
3. Estimate the maxima and minima of multi variable functions.
4. Evaluate area as double integrals and volume as triple integrals in engineering applications.
5. Illustrate the application and physical meaning of gradient, divergence and curl.

Module I
Ordinary differential equations:
First order differential equations - exact differential equations, Bernoulli's equations--Methods of solution and Simple applications.
Linear differential equations of higher orders with constant co-efficient-Methods of solution of these equations. Cauchy's linear differential equations. Simultaneous linear differential equations- Simple applications of linear differential equations in engineering problems – Electrical Circuits, Mechanical Systems.

Module II
Partial differentiation: Partial differentiation-Concept of partial derivative - Chain rule- Total derivative- Euler's theorem for homogeneous functions, Differentials and their applications in errors and approximations, Jacobians - Maxima minima of functions of two variables(Proof of the result not required)-Simple applications.
Co-ordinate systems: Rectangular co-ordinates-Polar co-ordinates-In plane and in Space-Cylindrical polar co-ordinates-Spherical polar co-ordinates.

Module III
Integral calculus:
Application of definite integrals: Area, Volume, Arc length, Surface area.
Multiple integral: Evaluation of double integrals-Change of order of integration. Evaluation of triple integrals-Change of Variables in integrals.
Applications of multiple integrals. Plane Area, Surface area &Volumes of solids

Module IV
Vector calculus: scalar and vector point functions, gradient and directional derivative of a scalr point function, divergence and curl of vector point functions, their physical meaning. Evaluation of line integral, surface integral, and volume integrals, Gauss's divergence theorem, Stoke's theorem (No proofs), conservative force fields, scalar potential.
References:

1. Sastry, S.S. Engineering mathematics: Vol1. (Fourth edition).PHI Learning, New Delhi. (2008).
2. Erwin Kreyzig. Advanced engineering mathematics (Tenth edition). John Wiley& Sons, Hoboken, NJ.(2011)
3. Veerarajan, T. Engineering mathematics.(third edition). Tata McGraw Hill Publishers, New delhi. (2011)
4. Grewal, B.S. Higher engineering mathematics. (Forty third Edition). Khanna Publishers, New Delhi. (2013).

19-200-0102B/ 19-200-0202A ENGINEERING PHYSICS

Course Outcomes:

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

1. Interpret modern devices and technologies based on lasers and optical fibres.
2. Explain the basic principles of crystal physics and applications of liquid crystals.
3. Summarise the characteristics and applications of nano materials and superconducting materials
4. Explain the factors affecting the acoustics of buildings and application of ultrasonics in non-destructive testing.

Module I

Laser-introduction—properties-interaction of radiation with matter-absorption-spontaneous and stimulated emission-principle of laser--Einstein coefficients-conditions for getting laser- population inversion- metastable state- pumpimg-Basic components of a laser-Different types of lasers- construction,working and applications of Ruby laser-Neodymium YAG laser- He-Ne laser- semiconductor laser-Applications of laser in medicine, industry, science and communication. **Holography**-basic principle-Comparison with ordinary photography-Recording and reconstruction of holograms - applications.

Fibre optics - Basic structure of an optical fibre - propagation of light in an optical fibre-classifications-step-index fibre and graded index fibre- single mode and multimode-Numerical aperture of a step-index fibre, graded index fibre---acceptance angle and acceptance cone-modes of propagation- Attenuation in optic fibres-fibre losses-material loss,scattering loss,absorption loss,leaky modes- dispersion in optical fibres-Applications.

Module II

Crystallography – Space lattice- Basis- Unit cell- Unit cell parameters- Crystal systems-Bravais lattices-Three cubic lattices-sc, bcc, and fcc- Number of atoms per unit cell- Co-ordination number- Atomic radius-Packing factor- Relation between density and crystal lattice constants- Lattice planes and Miller indices-Separation between lattice planes in sc-Bragg's law- Bragg's x-ray spectrometer- Crystal structure analysis.

Liquid crystals- Liquid crystals, display systems-merits and demerits- Metallic glasses-Types of metallic glasses (Metal-metalloid glasses, Metal-metal glasses) – Properties of metallic glasses (Structural, electrical,magnetic and chemical properties). Shape memory alloys- Shape memory effect, pseudo elasticity

Module III

Introduction to nanoscale science and technology- nanostructures-classifications-nanoring, nanorod,nanoparticle,nanoshells,fullerence- surface occupancy-quantum confinement effect- Properties of nanoparticles- optical, electrical, magnetic and mechanical properties -nanocomposites- metallic nanocomposites and polymer nanocomposites-Applications of nanotechnology.

Superconductivity-Introduction--transition temperature-Meissner effect-effect of current-entropy-specific heat-isotope effect-penetration depth-.Types of superconductors-type 1 and type 2- cooper pair-BCS theory-(briefly)-AC Josephsons effect- DC Jospehsons effect- Flux quantisation-Squid-High temperature superconductors-Applications of super conductivity.

Module IV

Quantum mechanics-Introduction- quantum theory-black body radiation and Photoelectric effect (brief ideas only)-matter waves- de broglie wavelength-wave packet-uncertainty principle-wave function -Physical intrepretation -Time dependent Schrodinger equation for a free particle- Time independent Schrodinger equation-Particle in a Box (one dimensional) –Energy eigen values and wave functions.

Ultrasonics-production of ultrasonics -piezo electric effect-Magnetostriction effect-properties of ultrasonics- ultrasonic diffractometer and determination of velocity of ultrasonics in a liquid-Application of ultrasonics in non-destructive testing - Accoustics of building-reverberation-Absorption Coefficient- Sabines formula for reverberation time (no derivation)-Accoustic intensity- loudness-decibel-phon-conditions for good acoustics(Qualitative study).

References:

1. S. Mani Naidu, A Text book of Engineering Physics, Pearson.(2010)

2. A.S. Vasudeva, Modern Engineering Physics, S. Chand & Co.(2013)

3. Prabir K. Vasu and Hrishikesh Dhasmana, Engineering Physics, Ane books Pvt. Ltd.(2010)

4. S.O. Pillai and Sivakami, Applied Physics, New Age International (P) Ltd., Second Edition. (2008)

5. G.S. Raghuvanshi, Engineering Physics, Prentice Hall of India.(2008)

19-200-0103B/ 19-200-0203A ENGINEERING MECHANICS

Course Outcomes: On completion of this course, a student will be able to

1. Understand the principles of mechanics (statics and dynamics), the concept of free body diagrams and resolution of forces.
2. Apply the principles of mechanics, concept of free body diagrams and resolution of forces and equations of equilibrium or motion to given engineering or physical applications.
3. Analyse given engineering or physical applications and calculate the required parameters like forces, moments, various motion parameters like, displacement, velocity, acceleration, etc.
4. Ascertain the physical and mathematical meaning of quantities, like centroid, moment of inertia and their applications in engineering and locate centroid and calculate the moment of inertia or second moment of area of typical sections used in engineering.

Module I

Introduction to Mechanics: Definition and classification of mechanics – rigid body (statics and dynamics) and deformable body mechanics.

Forces and Force systems: Force and its characteristics, Principles of statics – concept of resultant and equilibrant, Composition and resolution of forces, force systems.

Coplanar Concurrent force system: Equilibrium of two, three and more than three forces, Moment of a force, Varignon's theorem of moments, Equations of equilibrium, Friction and its effects on bodies, Engineering applications.

Coplanar Parallel force System: Two parallel forces, General case of parallel forces in a plane, Centre of parallel forces, Centre of gravity, Centre of mass, Centroids of curves, areas and volumes – regular and composite, Pappus's theorems, Equilibrium of distributed forces in a plane, Applications of the concept of centroid in engineering practice.

Module II

Moment of Inertia: Concept of moment of inertia and second moment of area, Moment of inertia of regular and composite solids, Second moment of area of regular and irregular surfaces, Polar moment of inertia / second moment of area, Product of inertia, Principal moments of inertia and principal axes, Applications of the concepts in engineering practice.

Coplanar non-concurrent force system and Analysis of Plane trusses and frames: Resultant of a general case of force system in a plane, Equilibrium equations, Concept of load carrying mechanism in trusses and frames – internal (axial) forces, two force and multi force members, Analysis of plane trusses by Method of joints and Method of sections, Analysis of Plane frames by Method of members.

Module III

Principle of virtual work: Concept of virtual work and the principle of virtual work, Applications in engineering, Equilibrium of ideal systems, Stable and unstable equilibrium.

Introduction to Dynamics: Definitions, Units, Divisions – Kinematics, Kinetics.

Rectilinear translation: Kinematics of rectilinear motion – displacement, velocity, acceleration, Kinetics – Differential equations of motion, D'Alembert's principle in rectilinear translation and its applications, Motion of a particle due to a constant force, Motion of a particle due to a force proportional to displacement – Simple harmonic motion, Momentum and impulse, Work and energy, Conservation of energy, Collision of two bodies – direct central impact.

Module IV

Curvilinear translation: Kinematics of curvilinear translation – components of displacement, velocity and acceleration, normal and tangential acceleration, Kinetics – Differential equations of motion, Motion of a projectile – projection on horizontal and inclined surfaces, D'Alembert's principle in curvilinear motion and its applications, Moment of momentum, Work and energy in curvilinear motion.

Rotation of a rigid body: Kinematics of rotation – angular displacement, velocity and acceleration, RPM, Relations of kinematic parameters of linear and angular motions, Kinetics – Differential equations of motion of a rigid body rotating about a fixed axis, Rotation under the action of a constant moment, Rotation proportional to angular displacement – Compound pendulum, D'Alemberts principle in rotation, Resultant inertia force in rotation, Principle of angular momentum in rotation, Energy equation for rotating bodies.

References

1. Timoshenko and Young. Engineering mechanics. McGraw Hill Book Company, Singapore. (1956)
2. Beer, F. P. and Johnston, E. R. Mechanics for engineers (Vol. 1: Statics and Vol.2: Dynamics). Tata McGraw Hill, New Delhi.(2004).
3. Merriam, H. L. and Kraige, L. G. (2003). Engineering mechanics (Vol. 1: Statics and Vol.2: Dynamics*)*. John Wiley and Sons, Somerset, N.J.(2003)
4. Hibbeller, R.C. Engineering mechanics. Vol. 1: Statics, Vol. 2: Dynamics. (Twelfth edition). Pearson Education Asia Pvt. Ltd., New Delhi.
5. Rajasekaran,S. and Sankarasubramanian,.G. Fundamentals of engineering mechanics. (Third edition). Vikas Publishing House Pvt. Ltd., New Delhi.(2010)

19-200-0104B/19-200-0204A BASIC CIVIL ENGINEERING

Course outcomes

At the end of the course students will be able to

1. Summarize the types, uses and properties of various building materials
2. Explain the different components of building and types of foundations
3. Illustrate the fundamental aspects of civil engineering
4. Discuss about the surveying techniques and to solve problems related with levelling
5. Recognize the various modern services emerging in the field of civil engineering
6. Prepare site plan based up on the Kerala Municipality Building Rule

Module I

Engineering Materials: Cement - varieties and grade of cement and their uses. Cement mortar- Steel- types of steel for reinforcement bars, steel structural sections. Brick- varieties and strength, tests on bricks.

Aggregates- types & requirements. Concrete- grades of concrete as per IS code, water cement ratio, workability, mixing, batching, placing, compaction and curing.

Module II

Construction : Components of a building-Foundation- types of foundations- isolated footing, combined footing, raft, pile & well foundations- Foundation for Machinery

Super structure: Brick masonry, English bond and Flemish bond, Stone masonry-Ashlar masonry- Rubble masonry. Roofing- Steel trusses, roofing for industrial buildings

Module III

Surveying: Basic Principles of surveying, instruments, methods and measurements- linear measurements- reconnaissance, selection of survey stations.

Leveling: Leveling instruments, different types, temporary adjustments, reduced level of point, booking of field notes, and reduction of levels by height of collimation method.

Introduction to Total Station.

Module IV

Site planning and Building Rules-Selection of site-Site plan preparation for buildings-Kerala Municipal Building Rules prevailing, general provisions regarding site and building requirements-Coverage and Floor Area Ratio-Basic concepts of Intelligent Buildings and Green Buildings

Roads- Classification of Rural and urban Roads.

Sources of Water - Water Supply-Quality of Water.

References:

1. Chudley, R., Construction Technology, Vol. I to IV, Longman Group, England (2011).
2. Chudley, R. and Greeno, R., Building Construction Handbook, Addison Wesley, Longman Group, England (1998)
3. Mamlouk, M. S., and Zaniewski, J. P., Materials for Civil and Construction Engineering, Pearson Publishers (2011)
4.McKay, W. B. and McKay, J. K., Building Construction, Vol. 1 to 4, Pearson India Education Services.(2013)
5. Rangwala,S.C and Dalal,K.B.,Building Construction, Charotar Publishing House (2017).
6. Kerala Municipal Building Rules (latest revision)

19-200-0105B/19-200-0205A BASIC MECHANICAL ENGINEERING

Course Outcomes:

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

1. Understand basics of thermodynamics and working of steam turbines
2. Understand basics of internal combustion engines, refrigeration and air conditioning
3. Gain knowledge on the working of hydraulic turbines and centrifugal pumps
4. Identify manufacturing methods encountered in engineering practice and understand mechanism of power transmission

Module I

Thermodynamics: Thermodynamics systems – open, closed and isolated systems, equilibrium state of a system, property and state, process, cycle, Zeroth law of thermodynamics- concept of temperature, temperature scales. First law – internal energy, enthalpy, work and heat, Different processes (isobaric, isochoric, isothermal, adiabatic and polytropic processes). Second law – Kelvin-plank and Claussius statements and their equivalence, Carnot Cycle (Elementary problems only).

Thermodynamic properties of Steam, Steam Generator. Different types of boilers, boiler mountings and accessories. Formation of steam at constant pressure, working of steam turbines, compounding of turbines.

Module II

Internal Combustion Engines: Air standard cycles – Otto and Diesel cycles, working of two stroke and four stroke Petrol and Diesel engines, Carburetted and MPFI engines, fuel pump, fuel injector, ignition system, cooling system, lubricating system.

Refrigeration & Air-conditioning: Introduction to refrigeration and air -conditioning, Rating of refrigeration machines, Coefficient of performance, Simple refrigeration vapour compression cycle (Elementary problems only), Summer and winter air conditioning.

Module III

Hydraulic Turbines & Pumps: Introduction, Classification, Construction details and working of Pelton Wheel, Francis and Kaplan turbines, Specific speed (Definition and significance only), Classification of water pumps, working of centrifugal pumps and reciprocating pumps (Theory of working principles only)

Power plants: Hydro-electric power plants, Thermal power plants, Nuclear power plants, Diesel power plants, Wind mills, solar energy (Working principles using schematic representations only)

Module IV

Introduction to Manufacturing Systems: Welding- different types of welding, resistance welding, arc welding, gas welding, Brazing and soldering, Different welding defects. Casting- different casting processes, sand casting, casting defects, Rolling- hot rolling and cold rolling, two high, three high , cluster rolling mills, wire drawing, forging, extrusion, Heat treatment of steel, elementary ideas of annealing, hardening, normalizing, surface hardening.

Power Transmission Methods and Devices: Introduction to Power transmission, Belt, Rope, Chain and Gear drive. Length of belt open and crossed. Ratio of belt tensions (Elementary problems only). Different types of gears (Elementary ideas only). Types and functioning of clutches.

References

1. Nag, P.K. Engineering thermodynamics. (Fifth Edition). McGraw Hill Education (India) Pvt. Ltd, New Delhi.(2013).
2. Gill, J.H. Smith Jr. and Ziurys, E.J. Fundamentals of internal combustion engines, Oxford & IBH, New Delhi.(1959)
3. Stoecker, W. F. Refrigeration and air conditioning. Tata McGraw Hill, New Delhi.(1980).
4. JagadishLal. Hydraulic machines. Metropolitan Book co, New Delhi.(1994)
5. Raghavan, V. Material science and engineering, Prentice Hall of India, New Delhi.(2004)
6. Rajendar Singh.Introduction to basic manufacturing processes and workshop technology, New Age International, New Delhi. (2006).

19-200-0106B/19-200-0206A SOFT SKILLS DEVELOPMENT

Course Outcomes:

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

1. Speak English at the formal and informal levels and use it for daily conversation, presentation, group discussion and debate.
2. Read, comprehend and answer questions based on literary, scientific and technological texts
3. Develop self-motivation, raised aspiration, belief in one's own abilities and commitment to achieving one's goal
4. Demonstrate emotional maturity and emotional health.

Module I

Role and importance of verbal communication, Everyday active vocabulary, Common words used in transitions, enhancing vocabulary, affixes and changes in pronunciation and grammatical functions, words often confused in pronunciation and usage. Passage comprehension- skimming, scanning techniques, note making, note taking and summarizing. Deciphering meaning from contexts. Two types of meaning- literal and contextual. Constructive criticism of speeches and explanations.

Module II

Fundamental grammar, Simple structures, passivizing the active sentences, reported speech, the judicious use of tenses and moods of verbs, forming questions and conversion from questions to statements and vice versa, forming open –ended and close- ended questions. Words and style used for formal and informal communication. Practice converting informal language to formal, the diction and the style of writing. Dealing with the nuances of ambiguous constructions in language. Learning authoritative writing skills, polite writing and good netiquette. Writing for internships and scholarships.

Module III

Kinesics, Proxemics, Haptics, and other areas of non-verbal communication, fighting communication barriers, positive grooming and activities on the same.

Different types of interviews, and presentation - oral, poster, ppt. Organizing ideas for group discussions, the difference between GD and debates.

Effective listening and seeking to understand others' perspectives.

Non-violent negotiation and persuasion, communicating across age groups, cultures or identity groups

Module IV

Developing positive self: Understanding oneself, A realistic awareness of oneself and one's abilities, strengths and potential, Self-esteem, Self-efficacy, steps for improvement.

Intra-personal skills – Self-control, emotional regulation and self-discipline, conscientiousness, dutifulness, reliability, truthfulness, honesty and trustworthiness. Goal orientation and initiative. Time management – prioritising work.

Interpersonal skills – cross cultural competence and valuing diversity of perspectives, respecting and expressing concern for others. Empathy and ability to notice the effect of one's actions on others, tolerance for disagreement, conflict management and resolution. Critical thinking and evaluation.

References:

1. Duck, Steve and David T. Macmahan. Communication in Everyday Life. 3rd Ed. Sage, (2017).
2. Gamble, Kawl Teri and Michael W. Gamble. The Public Speaking Playbook. Sage, (2015).
3. Raman, Meenakshi and Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press, (2015).
4. Coleman, D. Emotional intelligence: Why it can matter more than IQ, Bantam Books, New York (2006).
5. Devadas Menon. Stop sleep walking through life, Yogi Impressions Books Pvt. Ltd, Mumbai (2012).
6. Barun K Mitra. Personality Development and Softskills, Oxford University Press (2012).

ASSESSMENT

1. 'Soft Skills Development' is a practical and activity oriented course which has continuous assessment for 50 marks based on class room interaction, activities, and assignments. The activities may include 'Just a Minute' (JAM) sessions, group discussion, role play, debate, and extempore speech.

The weightages for the different components shall be as follows:

Class room interaction – 10 marks
Activities – 30 marks
Assignments (mainly from Modules I and II) – 10 marks

2. End semester examination is not envisaged.

3. A student should secure a minimum of 50% marks in continuous assessment for a pass in the course.

19-200-0107B/19-200-0207A CIVIL ENGINEERING WORKSHOP

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

1. Identify simple plumbing and sanitary fittings and state its use
2. Identify the various methods used in building construction.
3. Construct brick walls using English Bond and Flemish Bond
4. Set out a building as per a given building plan using surveying instruments
5. Compute the various quantities of materials required for a building

Plumbing:
Introduction to simple plumbing and sanitary fittings.

Building Materials:
Familiarization of building materials and their testing.

Masonry:
Construction of English bond and Flemish bond – wall junction – one brick – one and a half brick –and two brick thick

Surveying:
Surveying and levelling instruments
Setting out of building (single room only) as per the given building plan using surveying instruments
Compute the area and/or volume of various features of a building/structure such as door and window size, number of bricks required to construct a wall of a building, diameter of bars used in windows etc. (to create an awareness of measurements and units)
Demonstration of Total Station

Assignment: *Students shall collect the list of various building materials used for the construction of a building including their market rate.*

19-200-0108B/19-200-0208AMECHANICAL ENGINEERING WORKSHOP

Course Outcomes:

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

1. Identify and use tools, and make different types of joints used in carpentry, fitting, and sheet metal shop.
2. Compare basic fabrication techniques of different types of welding.

Preliminary exercises for beginners in all the following shops. Specific models may be designed by the teachers.

1) Fitting Shop.
2) Sheet Metal Shop
3) Foundry Shop
4) Welding Shop
5) Carpentry Shop

19-200-0109B/19-200-0209A LANGUAGE LAB

Course Outcomes:

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

1. Test pronunciation skills through stress on word accent, intonation, and rhythm.
2. Use English language effectively for writing business letters, resume, minutes of meeting and reports.
3. Use English language effectively to face interviews, group discussions, and public speaking.

Following course content is prescribed for the **Language Laboratory** sessions:

1. Introduction to the Sounds of English- Vowels, Diphthongs & Consonants.
2. Introduction to Stress and Intonation.
3. Preparing business letters
4. Preparing a resume
5. Conducting a meeting and writing the minutes
6. Writing a report
7. Situational Dialogues / Role Play.
8. Oral Presentations- Prepared and Extempore.
9. 'Just A Minute' Sessions (JAM).
10. Describing Objects / Situations / People.
11. Debate
12. Group discussion

19-200-0110B/19-200-0210A NSS/NATURE CONSERVATION ACTIVITIES

NATIONAL SERVICE SCHEME (NSS)

Course Outcomes:

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

1. Recognise the community in which they work
2. Utilise their knowledge in finding practical solution to individual and community problems

A student enrolling as member of NSS will have to complete 10 hours of training / social service.

NATURE CONSERVATION ACTIVITIES

Course Outcomes:

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

1. Practice and spread the message of sustainable life styles
2. Understand the importance of green plants in mitigating global environmental problems
3. Identify suitable waste management practices for the local community

A student enrolling as member of the Nature Conservation Club will have to complete 10 hours of campus cleaning and greening activities.

19-200-0301 LINEAR ALGEBRA & TRANSFORM TECHNIQUES
(Common for all branches)

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

1. Solve linear system of equations and to determine Eigen values and vectors of a matrix.
2. Exemplify the concept of vector space and sub space.
3. Determine Fourier series expansion of functions and transform.
4. Solve linear differential equation and integral equation using Laplace transform.

Module I.
Linear Algebra 1:Rank of a matrix, solution of linear system of equations- existence, uniqueness, general form-Eigen values and Eigen vectors- properties of Eigen values - Diagonalization of a matrix - Cayley Hamilton theorem (without proof) Verification-Finding inverse and power of a matrix using it-Quadratic form-orthogonal reduction of quadratic form to Canonical form.

Module II
Linear Algebra 2: Vector space-subspace-Linear dependence and independence-Spanning of a subspace- Basis and Dimension. Inner product- Inner product spaces - Orthogonal and Orthonormal basis –Gram- Schmidt Orthogonalization process. Linear Transformation.

Module III
Fourier Analysis: Periodic function, Fourier series, Functions of arbitrary period, Even and odd functions, Half Range Expansion, Harmonic analysis, Complex Fourier Series, Fourier Integrals, Fourier Cosine and Sine Transform, Fourier Transform.

Module IV
Laplace Transforms: Gamma functions and Beta function-Definition and properties, Laplace transforms. Inverse Laplace Transform, Shifting theorem, Transform of Derivative and Integrals, Solution of differential equation and integral equation using Laplace transform, Convolution, Unit step function, Second Shifting theorem, Laplace transform of periodic function.

References:
1. Erwin Kreyzig. Advanced Engineering Mathematics. (tenth edition). John Wiley & Sons, Hoboken, N.J (2010).
2. Grewal, B.S. Higher Engineering Mathematics. (forty third edition). Khanna Publishers, New Delhi. (2013).
3. Hsiung,C.Y and Mao, G. Y. Linear Algebra. World Scientific, New Jersey. (1999).
4. Hoffman, K. and Kunze, R. Linear Algebra. Prentice Hall of India, New Delhi. (1971).
5. Venkataraman,M.K. Linear Algebra. The National Publishing Co, Chennai. (1999).

19-206-0302 CHEMICAL PROCESS PRINCIPLES

Course Outcomes

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

1. Exemplify material balance for various unit operations or processes with or without chemical reaction.
2. Solve energy balance on processes with and without reaction
3. Explain the properties of thermodynamic systems and interpret the significance of the laws of thermodynamics.
4. Summarize the working principle of the major equipments for screening, size reduction, and filtration.

Module I

Material balance

Introduction to chemical engineering, basic chemical calculations-mole concept, methods of expressing composition-mole fraction, weight fraction, volume fraction, concentration of liquid solutions- molarity, molality, normality, ppm. Ideal gases and gas mixtures- ideal gas law, Amagat's law, Dalton's law, Henry's law, average molecular weight, density of gases, partial pressure and partial volume calculations. Material balance involving chemical reactions and not involving chemical reactions, simple calculations involving recycle, bypass and purge streams.

Module II

Energy balance

Energy balance- heat capacity, specific heat and enthalpy, heat capacity of gases at constant pressure, heat capacity of gaseous mixtures, latent heats, enthalpy changes accompanying chemical reactions- standard heat of formation and standard heat of combustion, standard heat of reaction.

Module III

Chemical Engineering Thermodynamics

Chemical thermodynamics, fundamental concepts and definitions- types of thermodynamic systems and properties- closed, open and isolated system- intensive and extensive properties- path and state functions, first law of thermodynamics, second law of thermodynamics, entropy, change in entropy, Maxwell relations, heat capacity in terms of entropy, equation of state of gases, the principle of corresponding states, compression and expansion of fluids – Joule Thomson expansion. Gibbs free energy change, equilibrium constant, effect of temperature on equilibrium constant.

Module IV

Mechanical Operations

Solids: Properties of solids, screening, screening equipment, effectiveness of screens, sieve analysis, average diameter and specific surface. Size reduction, types of equipment used in the various stages of reductions. Laws of crushing & grinding power requirements.

Belt conveyer, bucket conveyer, pneumatic conveyers. Capacity and power requirements of conveyers.

Flow of solids through fluids, terminal settling velocity & hindered settling. Laboratory batch sedimentation, Kynch theory, calculation of area and depth for continuous thickeners.

Filtration: Filtration theory, equipment for filtration, constant pressure and constant rate filtration, filter calculations, optimum cycle time & filter aids.

References:

1. McCabe, W.L., J.C. Smith, J.C. and Peter Harriott. Unit operations of chemical engineering. (Seventh edition). McGraw-Hill Education, New York. (2004).
2. Bhatt, V.I. and Vora, S.M. Stoichiometry. (Fourth edition). Tata McGraw Hill, New Delhi. (2004).
3. Narayanan, K.V. and Lakshmikutty, B. Stoichiometry and process calculations. Prentice-Hall of India Pvt. Ltd, New Delhi. (2006).
4. Narayanan, K.V. A text book of chemical engineering thermodynamics. Prentice Hall of India Pvt Ltd, New Delhi. (2013).
5. Badger, W.L. and Banchero, J.T. Introduction to chemical engineering. Tata McGraw Hill Education, New Delhi. (1997).
6. Christe J. Geankoplis. Transport process and unit operations, Prentice Hall India Pvt Ltd, New Delhi. (1993).

19-206-0303 ENGINEERING FLUID MECHANICS AND MACHINERY

Course Outcomes:

On completion this course the student will be able to:

1. Analyse fluid flow behaviour under different operating conditions
2. Apply equations of motion to flow problems
3. Estimate the major and minor losses associated with fluid flow in piping networks.
4. Select hydraulic machines based on the type of operation

Module I

Scope of fluid mechanics – Dimensions and units – Definition of fluid - Fluid properties – density, specific weight, pressure, viscosity, surface tension and capillarity, compressibility – Rheological classification of fluids..

Fluid Statics – Pressure at a point – Basic equation of fluid statics – Hydrostatic equations for incompressible and compressible fluids – Hydrostatic force on a submerged plane and curved surfaces – Buoyancy and equilibrium of floating bodies – Absolute and gauge pressure – Pressure measurement by manometers and pressure gauges.

Module II

Fluid Kinematics and Fluid Dynamics - continuum Lagrangian and Eulerian approaches – Classification of fluid motions – path line, stream line, streak line, stream tube, one, two and three dimensional flow, velocity field – acceleration of fluid particle in a velocity field- Continuity equation (one and three dimensional differential forms) - equation of stream line – stream function – velocity potential function – circulation – flow net – fluid dynamics – equations of motion – Euler's equation along a streamline – Bernoulli's equation – applications – constant head and area meters.

Module III

Incompressible Fluid Flow – Viscous flow – Navier – Stoke's equation (statement only) – Shear stress, pressure gradient relationship – Laminar flow through circular tubes (Hagen Poiseulle's) – Hydraulic and energy gradient – flow through pipes – Darcy-weisbach equation – pipe roughness – friction factor – Moody's diagram – minor losses – flow through pipes in series and in parallel.

Boundary layer flows, boundary layer thickness, and boundary layer separation – drag and lift coefficients. Characteristics of fluidization, Aggregative and particulate fluidization, incipient fluidization velocity, Applications of packed and fluidized beds.

Module IV

Hydraulic machines: definition and classification – exchange of energy.

Hydro turbines: definition and classification – Francis turbine – Kaplan turbine – working principle – work done – specific speed – efficiency.

Pumps: definition and classification – Centrifugal pump: working principle, velocity triangles, specific speed, efficiency and performance curves – Reciprocating pumps: working principle, indicator diagram and performance curves – cavitation in pumps – NPSH – Priming.Rotary pumps: working principle of gear and vane pumps.

References:

1. Kumar, K.L. Engineering fluid Mechanics. (seventh edition). Eurasia Publishing House (P) Ltd, New Delhi. (1995*).*
2. McCabe, W.L. Smith J.C. and Harriot, P. Unit operations in chemical engineering. (sixth edition). McGraw-Hill, New York. (2000).
3. Vasandani, V.P. Hydraulic machines – theory and design. Khanna Publishers, New Delhi. (1992).

4. Streeter,V.L. and W y l i e ,E.B. Fluidmechanics, McGrawHill, NewYork. (1983).
5. Som S K, Gautam Biswas and Chakraborty S Introduction to fluid mechanics and fluid machines. (Third edition), McGraw Hill Education, New Delhi. (2017).
6. dward J. Shaughnessy Jr. Ira M. Katz. and James P. Schaffer. Introduction to fluid mechanics. Oxford University Press, New Delhi. (2005).

19-206-0304 FIRE ENGINEERING FUNDAMENTALS

Course Outcomes

On completion of this course the student will be able to

1. Explain the theory of fire chemistry and the different kinds of combustion and their characteristics
2. Summarize the characteristics of diffusion and premixed flame
3. Explain the theory of heat transfer mechanism in compartment fires.
4. Describe the use and operation of fire service equipment, machineries and accessories.
5. Calculate the water requirement and the pump capacity for fire fighting.
6. Recognize the basic fire ground operations.

Module I

Introduction- temperature, heat, specific heat, flash point, fire point, ignition, combustion; Ignition- pilot ignition, spontaneous ignition, ignition sources; Types of combustion-rapid, spontaneous, physical explosion, chemical explosion; Smoldering combustion; Product of combustion harmful to human-flame, heat, smoke, fire gases; Special kinds of combustion- Flash fire, Pool fire, Deep seated fire, Spillover, Boil over, Dust explosion, BLEVE, VCE; Classification of fire based on material

Development of enclosure fire in terms of temperature-incipient, smoldering, flame and heat stages; factors influencing fire development in an enclosure;

Diffusion flames-Zones of combustion, characteristics of diffusion flames , laminar and turbulent jet flames, flame from natural fires, buoyant plume; Premixed flames-structure, limits of flammability, burning velocity, explosion and expansion ratios, deflagration and detonation, characteristics of premixed flame; Spread of flames over liquid and solid surfaces.

Module II

Heat transfer in compartment fires- Fuels, Calorific value, fire load, heat release rate and factors controlling heat release rate, basic heat transfer equations, Convective heat transfer in fire, Radiative heat transfer in fire; Radiation from hot gases and non-luminous flames; Radiation from luminous flames and hot smoky gases.

Fire plumes and flame heights- flame characteristics, mean flame height, flame height correlations, turbulent fire plume characteristics, ideal plume, line plume, bounded plume, ceiling jets, response of ceiling mounted fire detectors, interaction between sprinkler spray and the fire plume.

Module III

Use, operation and maintenance of fire service equipments and accessories- Suction and delivery Hose, Hose reel, Hose fittings-coupling, adapters, branches, branch holders, radial branches, collecting heads, stand pipe, monitors, hydrants; Introduction to fire fighting vehicles and appliances- crash tenders, rescue tenders, hose laying tenders, control vans, hydraulic platforms; Ladders- extension ladders, hook ladder, turntable ladders, snorkel; Fire pumps and primers; Uses and maintenance of small gear and miscellaneous equipments used during fire fighting; Lamps and lighting sets; Ropes and Lines- wire and rope lines used in fire service, use and testing of lines, knots, bends and hitches and general rope work.

Module IV

Fire Hydraulics- path and range of fire stream, types of nozzles and calculation of discharge capacity, nozzle reaction; Pressure loss or gain because of elevation; back pressure; Flow in pipes and fire hoses-hydraulic and energy grade lines, friction loss in pipes, fire hoses and fixtures, parallel and series connection of fire hoses, branching lines; Water relay techniques; Estimation of fire protection water requirements, pump capacity and other parameters relating to fire hydraulics.

Fire ground operations - preplanning, action on arrival and control, methods of rescue, methods of entry. Personnel safety. Control procedure and use of other safety equipment. Ventilation and salvage operations.

References:

1. Ron Hirst Underdowns practical fire precautions, Gower publishing company Ltd., England. (1989).
2. Gupta, R.S. A Hand book of fire technology (2nd edn.). Universities Press Pvt. Ltd., New Delhi.(2010).
3. Andrew L Simon, Fire hydraulics Prentice-Hall Inc., USA. (1983).
4. Bjorn Karlsson and James G. Quintiere, Enclosure Fire Dynamics, CRC Press, USA (2000).
5. Dougal Drysdale An Introduction to Fire Dynamics, (2nd edn.), John Wiley & Sons Ltd., England. (1999)
6. Jain V.K. Fire safety in buildings (2nd edn.). New Age International (P) Ltd., New Delhi. (2010).

19-206-0305 ELEMENTS OF MACHINE DRAWING*

Course Outcomes:
On completion of this course the student will be able to:
1. Draw orthographic views from pictorial views of blocks, brackets, hangers and simple machine parts.
2. Draw the orthographic views of screw threads, screws, bolts and nuts.
3. Draw the orthographic views of pipe joints and detachable joints from pictorial views.
4. Make the assembly drawings of valves from dissembled parts.

Module I
Introduction to Machine Drawing: Conversion of pictorial views to orthographic views

Screwed fastenings: Screw thread forms, V and Square threads, Conventional representation of threads, Hexagonal headed bolt and nut, Square headed bolt and nut, Nut locking arrangements, Foundation bolts (common types, special types and detachable types)..

Module II
Cotter and Pin joints: Socket and Spigot joints, Gib and Cotter joint for rectangular rods, Sleeve and Cotter joints, Knuckle joint.

Pipe joints: Coupler joints, Nipple joints, Union, Socket and Spigot joints, Integral flanged joints and Hydraulic joints. Single line orthographic symbols for pipe fittings.

Module III
Assembly drawings of : Non-return valve, steam stop valve, Rams bottom safety valve, Lever safety valve, Feed check valve and Cylinder relief valve.

References:

1. Bhatt, N.D. Elementary engineering drawing. (Forty ninth edition). Charotar Publishing House, Anand. (2010)
2. Parkinson, A.C. A first year engineering drawing. Pitman, London. (1958).
3. Gill, P.S. A textbook of machine drawing. S.K. Kataria & Sons, Ludhiana. (2010).
4. John, K.C. Text Book of Machine Drawing. PHI Learning Pvt. Ltd., New Delhi. (2009).
5. Bhattacharyya, Basudeb. Machine drawing. Oxford University Press India, New Delhi. (2011).

Type of Questions for Semester End Examination
The Examination shall be of 4 hours duration
Module I: Two questions A&B of 14 marks each with option to answer either A or B
Module II: Two questions A&B of 24 marks each with option to answer either A or B
Module III: Two questions A&B of 34 marks each with option to answer either A or B

19-206-0306 PRINCIPLES OF SAFETY MANAGEMENT

Course Outcomes:

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

1. Explain the concepts of safety and safety equipments and safety organisation
2. Analyse job safety, accidents through accident models, estimate costs
3. Estimate safety performance using various indices
4. Produce different types of permits, reports, and compliance check lists.

Module I

Introduction-Safety -Goals of safety engineering. Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. History of safety movement. Theories of accident causation. Safety organization-objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety. Safety policy. Safety Officer-responsibilities, authority. Safety committee-need, types, advantages

Module II

Accident prevention Methods- Engineering, Education and Enforcement. Safety Education & Training -Importance, Various training methods, Effectiveness of training, Behaviour oriented training. Communication- purpose, barrier to communication. Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. 5 s of housekeeping. Work permit system- objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces.

Module III

Personal protection in the work environment, Types of PPEs, Personal protective equipment-respiratory and non respiratory equipment. Standards related to PPEs. Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate. Cost of accidents-Computation of Costs- Utility of Cost data. Plant safety inspection, types, inspection procedure. Safety sampling techniques. Job safety analysis (JSA), Safety surveys, and Safety audits. Safety Inventory Technique.

Module IV

Accident investigation –Why? When? Where? Who? & How? Basics- Man- Environment & Systems. Process of Investigation –Tools-Data Collection-Handling witnesses- Case study.

Accident analysis –Analytical Techniques-System Safety-Change Analysis-MORT-Multi Events Sequencing-TOR.

References:

1. Krishnan, N.V. Safety management in Industry. Jaico Publishing House, New Delhi.(1997).
2. John V. Grimaldi and Rollin H.Simonds Safety management. All India Traveller Book Seller, Delhi. (1989).

3. Ronald P. Blake Industrial safety. Prentice Hall, New Delhi. (1973).
4. Ted S. Ferry Modern accident investigation and analysis, John Wiley & Sons, Hoboken, N.J. (1988).
5. Alan Waring Safety management system. Chapman & Hall, England. (1996).
6. National Safety Council Accident prevention manual for industrial operations. Chicago. (1982).

19-206-0307 FLUID MECHANICS AND MACHINERY LABORATORY

Course Outcomes:

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

1. Explain the principles of fluid flow.
2. Calculate the major and minor losses in fluid flow due to friction and pipe fittings.
3. Determine velocity of fluid flow using flow meters.
4. Select proper machinery for fluid transportation.

Experiments

1. Study of pressure gauge, flowmeters, and devices used to determine meta centric height and radius of gyration of floating bodies.
2. Determination of terminal settling velocities in a viscous medium.
3. Experimental verification of Bernoulli's theorem.
4. Steady flowthrough pipes-determination of friction factor and Reynolds number.
5. Determination of the loss coefficients for pipe fittings.
6. Calculation of hydraulic coefficients of mouthpieces, nozzles, and orifices.
7. Determination of the coefficient of discharge and calibration of venturimeter.
8. Determination of the coefficient of discharge and calibration of orifice meter.
9. Determination ofperformancecharacteristics ofcentrifugalpumpsat a constant speed.
10. Determination of constant head characteristics of a Pelton turbine.

19-206-0308 SAFETY ENGINEERING LABORATORY

Course Outcomes:

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

1. Recognize various safety gears, investigation procedure, various statutory forms and permits
2. Compute safety indices from accident data and predict threats to safety and environment
3. Evaluate and judge adequacy of job safety by JSA and auditing and prepare different types of reports
4. Design work permits and training modules on safety in industry and society

List of Experiments:

1. Study of personal protective equipments
2. Assessment of the safety performance of an industry and classification of accidents
3. Safety assessment of a construction site
4. Environmental impact assessment and environmental audit
5. Accident Reporting – Exercises
6. Job safety analysis – Exercises
7. Safety audit – Exercises, e.g., Labs, workshops, academic, administrative and residential buildings
8. Calculation of cost of accidents
9. Preparation of work permits
10. Preparation of a training module on any topic of safety for a target audience.

19-200-0401 COMPLEX VARIABLES AND PARTIAL DIFFERENTIAL EQUATIONS
(Common to all branches)

Course Outcomes:
On completion of this course the student will be able to:
1. Transform a region to another region using conformal mapping
2. Evaluate real integrals using residue theorem
3. Form and solve partial differential equation
4. Determine solution of partial differential equation for vibrating string and heat conduction

Module I
Analytic function- Cauchy-Riemann equation (Cartesian and polar)-Harmonic function-construction of analytic function given real or imaginary parts- Conformal mapping of standard elementary function and bilinear transformation.

Module II
Cauchy's integral theorem, Cauchy's integral formula and for derivatives-Taylor's and Laurent's expansion (without proof) - Singularities-Residues-Cauchy's Residues theorem- Contour integration involving unit circle.

Module III
Formation of partial differential equation eliminating arbitrary constants and function—Solution of first order equation-four standard types- Lagrange's equation—Linear homogeneous partial differential equation with constant coefficient.

Module IV
One dimensional wave equation, Alembert's solution and one-dimensional heat flow equation—solution by the method of separation of variables- application of Fourier series solution. Solution of Laplace's equation over a rectangular region by the method of separation of variables.

References:

1. Erwin Kreyzig. Advanced engineering mathematics. (Tenth edition). John Wiley & Sons, Hoboken, N.J. (2010)
2. Grewal, B.S. Higher engineering mathematics. (Forty third edition). Khanna Publishers, New Delhi. (2013).

19-206-0402 HEAT AND MASS TRANSFER OPERATIONS

Course Outcomes:

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

1. Explain different modes of heat transfer and carry out the process calculations in various geometries.
2. Recognise the basic methodology in designing heat exchangers and evaporators.
3. Estimate diffusion coefficients and convective mass transfer rates.
4. Select and design the most suitable equipment for absorption, distillation, liquid-liquid extraction, and solid-liquid extraction.

Module I

Importance ofheat transfer in Chemical Engineering operations -Modes of heat transfer- Concept of heat conduction - Fourier's law of heat conduction - one-dimensional steady state heat conduction equation for flat plate, hollow cylinder, hollow sphere - Heat conduction through aseries of resistances- Analogy between flow of heat and flow of electricity. Concept of heat transfer by convection - Individual and overall heat transfer coefficients and the relationship between them. Natural and forced convection - Application of dimensional analysis for convection- Equations for forced convection under laminar, and turbulent conditions - Equations for natural convection -- Heat transfer from condensing vapours-drop-wise and film type condensation,heat transfer to boiling liquids.

Module II

Heat Exchangers: Parallel and counter flow heat exchangers - Log mean temperature difference - Single pass and multipass heat exchangers; plate heat exchangers; use of correction factor charts; heat exchangers effectiveness; number of transfer unit - Chart for different configurations - Fouling factors and Wilson's plot - Design of heat exchangers.

Radiation: Concept of thermal radiations–Emissive power- Black body concept- Laws of radiation -concept of grey body - radiation between surfaces. Evaporation: Types of evaporation - single effect and multiple effect evaporation –Capacity- Design calculation for single and multiple effect evaporators.

Module III

Principles of mass transfer, Fick's law of molecular diffusion-Molecular diffusion in solids and liquids.Concept of mass transfer coefficients, mass transfer atfluid surfaces-interphase mass transfer- correlation of mass transfer coefficients, theories of mass transfer and theirapplications, interphase mass transferand over all mass transfer coefficients in binary systems. Absorption - Equilibrium and operatingline conceptin absorption calculations; types of contactors, design of packed and plate type absorbers; Operating characteristics of stage-wise anddifferential contactors, concepts of NTU, HTU and overall volumetric mass transfer coefficients.

Module IV

Distillation - relative volatility, simple distillation, steam distillation, distillation with reflux, principle of azeotropic and extractive distillation. McCabe Thiele method of

calculation ofnumber of theoretical stages, total, minimum and optimum reflux. Factors affecting column performance-flooding, priming, coning, weeping, loading.Introduction to drying-theory and mechanism, equilibrium moisture and free moisture, critical moisture content, bound and unbound water, rate of drying curves, classification of dryers-tray dryers, tower dryers, rotary dryers, fluid-bed dryers, spray dryers. Principle of liquid-liquid extraction, liquid-liquid equilibrium, equipment for liquidextraction - mixer-settlers, spray towers, Bollman extractor.Solid-liquid extraction- simple leaching, major equipments for solid-liquid extraction.

References:

1. BinayK.Dutta. Heat Transfer principles and applications. Prentice Hall of India, New Delhi.(2001)
2. Robert E. Treybal. Mass transfer operations. (Third edition). Mc Graw Hill Education, New York. (2012).
3. McCabe, W.L., J.C. Smith, J.C. and Peter Harriott. Unit operations of chemical engineering. (Seventh edition). McGraw-Hill Education, New York. (2004).
4. Anantharaman N and Meera Sheriffa Begum K.M, Mass Transfer Theory and Practice, Printice Hall of India Pvt. Ltd., New Delhi, (2013).
5. Kern, D.Q., Process Heat Transfer, McGraw Hill Co. Inc, (1999).
6. Christe J. Geankoplis. Transport process and unit operations, Prentice Hall India Pvt Ltd, New Delhi. (1993).

19-206-0403 STRENGTH OF MATERIALS

Course Outcomes:

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

1. Recognize the fundamental concepts of stress and strain in elastic bodies subjected to external loads.
2. Apply the concept of stress and strain in solving engineering problems.
3. Calculate bending moments, shear forces, axial forces and deformation characteristics of determinate beams.
4. Solve engineering problems related to thin and thick pressure vessels.
5. Solve engineering problems related to circular shafts, helical springs and buckling of columns.

Module I

Simple Stress and Strain and Principal Stresses

Axial stress and strain, elasticity, Hook's law – stress-strain relationship of ductile and brittle materials, Factor of safety, Stepped bars, Bars of uniformly varying cross-sections - Lateral Strain, Poisson's ratio -Volumetric strain - Shear stress and shear strain - Elastic constants and their relationships - stresses in composite bars due to axial loading and temperature - Strain energy due to axial load - stresses due to impact and suddenly applied loads.

State of stress at a point - Normal and tangential stresses on a given plane; Principal stresses and their planes, plane of maximum shear; Mohr's circle of stresses.

Module II

Shear Force and Bending Moment in Beams- Relationship connecting intensity of loading, shearing force and bending moment; Shear force and bending moment diagrams for cantilever, simply supported and overhanging beams subjected to concentrated load and UDL; Maximum bending moment and point of contra flexure.

Theory of simple bending-assumptions and limitations - Derivation of bending formula and its applications to engineering problems

Module III

Deflection of Beams- Differential equation of the elastic curve. Slope and deflection of beams by method of successive integration and McCaulauy's method.

Thin and Thick Walled Structures- Hoop and longitudinal stresses in thin walled cylindrical and spherical shells subjected to internal pressure; Changes in dimension and volume; Thick Cylinders - Lame's equations , shrink fit, compound cylinders, wire wound cylinders.

Module IV

Torsion- Theory of torsion and assumptions; Torsion of solid and hollow circular shafts; Power transmission, strength and stiffness of shafts.

Close and open coiled helical springs.

Theory of columns- buckling and stability, buckling of long columns, Euler's Formula, Long columns with different support conditions.

References:

1. James M Gere. Mechanics of Materials (5th edn.). Thomson Asia Pte. Ltd., Singapore. (2004).
2. Subramanian, R. *Strength of Materials* (3rd edn.) Oxford University Press, New Delhi. (2016).
3. Egor P Popov Engineering Mechanics of solids (2nd edn.), Pearson Education Pte. Ltd, Singapore. (2015).
4. Timoshenko S. P., and Young, D.N., Elements of Strength of materials (5th edn.), D.Van Nostrand Company Inc., (1977).
5. Ramamurtham, S. Strength of Materials (14th edn.). Dhanpat Rai and Sons. (2011).
6. Bhavikatti, S.S., Strength of materials (4th Edn.)", Vikas Publishing House Pvt. Ltd., New Delhi. (2013).

19-206-0404 PLANNING AND DESIGN OF FIRE PROTECTION SYSTEMS

Course Outcomes:

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

1. Explain the working principle of different types of fire detectors and alarm system and plan and distribute them in buildings of different occupancy.
2. Interpret the concept of fire extinguishment with different extinguishants and the working principle and operation of portable fire extinguishers.
3. Plan and distribute appropriate portable extinguishers in buildings of different occupancy.
4. Design fixed sprinkler system in buildings of different occupancy as per Indian Standard Specifications
5. Interpret appropriate standards for the design and installation of fixed CO_2 and DCP systems as per Indian Standard Specifications.
6. Interpret appropriate standards for the design and installation of fixed foam systems and apply these concepts in the design of typical hydrocarbon storage tank protection.

Module I

Fire detection- Need and importance of automatic fire detection system, principle of detection, classification of detectors; Heat detectors – fixed temperature, rate of rise , thermistor rate of rise and rate compensated type detectors; Smoke detectors- optical and ionization type, photo electric light scattering and light obstruction type detectors; Flame detectors – infra red and ultra violet detectors; Flammable gas detection- Pellistor and laser detectors; Testing of fire detection devices as per relevant Indian standards specifications; Performance characteristics of detectors; Lag time associated with fire detection; Comparison of detectors.

Fire alarm system- classification of alarm system as per National Building Code (NBC); Manually operated system; Automatic alarm system-various components and modules; Addressable and non-addressable system;
Siting of detectors as per relevant Indian standard specifications(BIS); Selection and planning of alarm system as per relevant BIS. General requirements and guidelines for the selection and installation of fire detection and alarm system in buildings of different occupancy classification; Performance and effectiveness of automatic fire detectors.

Module II

Principles of Fire Extinguishments-extinction of premixed flames, diffusion flames and burning metals; fire triangle, fire tetrahedron.

Basic concept of fire fighting with water, carbon dioxide, powders, foams, inert gases, halons; Need for halon replacement and halon substitutes; Extinguishant performance- flame extinguishing concentration, inerting concentration, fire trials.

Description, working principle, method of operation of different types of portable fire extinguishers-water type, foam type, dry powder type, CO_2 type, vapourizing liquid type; Selection and distribution of portable extinguishers for different occupancy classification as per NBC; Care, inspection, and maintenance of portable extinguishers as per relevant BIS. Performance and effectiveness of portable fire extinguishers.

Module III

Automatic water sprinkler system- requirement and source of water supply, automatic pumps; Sprinkler heads-Quartzoid type, fusible link type, modern types; mounting and protection of sprinkler heads; Sprinkler pipe works-standard and staggered lay out, hangers; Control valves for wet and dry installations; deluge valve; Drenchers; High velocity and medium velocity spray system. Performance and effectiveness of water sprinkler system.

Design of water sprinkler and spray system as per relevant BIS-application to illustrative problems.

Module IV

Fixed fire fighting system using CO_2, Dry chemical powder, and Foam - concept of total flooding and local application, advantages and disadvantages of each system; Basic system components and design principles as per relevant BIS.

Design of fixed foam type fire fighting systems for total flooding and for local application as per relevant BIS -Application to typical hydrocarbon storage tank protection problems.

References:

1. Ron Hirst. Underdowns practical fire precautions, Gower publishing company Ltd., England. (1989).
2. Jain V.K. Fire safety in buildings (2^{nd} edn.). New Age International (P) Ltd., New Delhi. (2010).
3. Barendra Mohan Sen. Fire protection and prevention the essential handbook, UBS publishers and Dist., New Delhi. (2013).
4. Rasbash D., Ramachandran G., Kandola B., Watts, J., Law M., Evaluation o Fire Safety, John Wiley & Sons Ltd., England, (2004).
5. Robert M Gagnon, Design of water based fire protection system, (2^{nd} edn.), Delmar Cegage Learning, USA. (2013).
6. Robert M Gagnon, Design of special hazard and fire alarm systems, (2^{nd} edn.), Thomson Delmar Learning, New York. (2008)
7. Relevant Indian Standard Code of Practices(BIS)

19-206-0405 ELECTRICAL TECHNOLOGY AND SAFETY

Course Outcomes:

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

1. Explain the constructional features and applications of electrical machines
2. Solve numerical problems related to the operation of electrical machines
3. Explain the working principle of various electrical safety equipments
4. Summarise the safety precautions to be taken during installation of plants and equipments

Module I

Construction and principle of operation of dc machines, e.m.f equation of a generator, use of interpoles. Characteristics of shunt, series and compound generators – starting and speed control – losses and efficiency, application of motor for industrial drive. Construction and principle of operation of single phase transformers, e.m.f equation, phasor diagrams, equivalent circuit, regulation, losses and efficiency. Instrument transformers CT, PT.

Module II

Synchronous machines - types – e.m.f equation. Synchronous motor, methods of starting, applications. Induction Motor; construction and principle of operation, equivalent circuit, torque slip characteristics, method of starting, applications.

Circuit breakers - SF_6, vacuum, air blast. Function of switch gear, circuit breakers principle of operation, arc phenomenon, arc interruption, recovery voltage and restriking voltage. MCB and ELCB. Faults in power systems – causes – types.

Module III

Fuses, types and selection of fuses, advantages and disadvantages. Grounding, neutral grounding, solid grounding, resistance grounding, arc suppression coil grounding. Equipment grounding for safety, spark gap, surge protection, lighting arrester, grounding of line structure. Effect of electric and magnetic fields, human safety aspects, effect of current and voltage on human beings. Electrical accident-safety precaution, electric shocks and their prevention. Insulation, FRLS insulation, continuity test. Protective relays, requirement of relay, types of protection, distance relay, differential relay, state relays and digital relay. Transmission line protection.

Module IV

Safety during installation of plant and equipment. Safe sequences in installation, risk during installation. Safety during testing and commissioning. Test on relays, protection and interlock systems for safety. Hazardous zones, classification of hazardous zones. Intrinsically safe and explosion proof electrical apparatus. Selection of equipments in hazardous area.

Electrical fires, hazards of static electricity. Safe procedures for electrical maintenance - Statutory requirements. Safety provisions in Indian Electricity Act & Rules.

References:

1. Cotton, H. Electrical technology. (Seventh edition). CBS Publishers and Distributors, New Delhi. (2005).
2. Kothari, D.P. and Nagrath, I.J. Basic electrical engineering. (Third edition). Tata McGraw Hill Publishing Company Ltd., New Delhi. (2009).

3. National Safety Council. Accident prevention manual for industrial operations. Chicago. (1982).
4. Fordham-Cooper, W. Electrical safety engineering. Elsevier by, Amsterdam. (1998).
5. Rao, S. and Saluja, H.L. Electrical safety, fire Engineering and safety Management, Khanna Publishers, Delhi. (2012).
6. Nagarath I.J. & Kothari D.P, Electric Machines, 3rd edition, Tata McGraw Hill, (2004).

19-206-0406 OCCUPATIONAL HEALTH AND FIRST AID

Course Outcomes:

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

1. Explain the concept and spectrum of health -functional units and activities of occupational health service.
2. Interpret physical chemical and biological hazards in the work environment and its control measures.
3. Recognize the principles of first aid.
4. Summarize the anatomy and functions of different human systems.

Module I

Concept and spectrum of health- functional units and activities of occupational health services- occupational and work related disease- Levels of prevention of diseases – notifiable occupational diseases such as silicosis, asbestosis, pneumoconiosis, siderosis, anthracosis, aluminosis and anthrax - Lead-Nickel, chromium and manganese toxicity- gas poisoning (such as CO, ammonia, coal and dust), their effects and prevention - Industrial toxicology – local and systemic and chronic effects, temporary and cumulative effects – threshold limit values, calculation of TLVs – carcinogens, mutagens, teratogens.

Instruments for Radiation detection and measurement. Early recognition of radiation hazard. Personal monitoring devices, Medical support. Hazards associated with the following radiations and preventive measures- Laser, infra-red, ultra violet and ELF.

Module II

Recognition, evaluation and control of physical hazards. Vibration –description and measurement of vibration. Vibration control methods. Effects of whole body vibration on human body and control measures.

Noise- noise measurement, evaluation, noise control methods -hearing loss – causes - Biological effects of noise exposure.

Thermal stress – heat disorders and health effects such as heat exhaustion, hear cramp etc. WBGT index, acclimatization. Ventilation systems - purpose of ventilation-general principles ventilation requirements. Physiological and comfort level. Natural ventilation - Dilution ventilation - Mechanical ventilation - Local exhaust ventilation - Ventilation measuring instruments. Fundamentals of hood and duct designs. Standards on ventilation.

Purpose of lighting. Advantages of good illumination. Lighting and the work. Sources and kinds of artificial lighting principles of good illumination. Design of lighting installation. Maintenance. Lighting and colour. Standards on lighting and illuminations.

Module III

Aims and Objectives. First Aid principles-Role of the first aider-sequence of action on arrival at scene. Vital signs-breathing -pulse. Introduction to the body-basic anatomical terms-body cavities-head- cranium - thorax-abdomen and pelvis. Biomechanics – Structure and functions of musculoskeletal systems, tendons, ligaments, facia, bone, muscles, joints and basic mechanisms.

The respiratory system-respiratory failure - asphyxia- abdominal thrust in Heimlich manoeuvre. Chest injuries-types-fractured ribs -pneumothrox- haemothrox.

The nervous system-functions-components -brain - cerebrum - cerebellum - medulla oblongata - cerebro - spinal fluid-spinal cord-autonomic nervous system. Unconsciousness-causes-level of consciousness-management of unconscious casualty-problems of unconsciousness. Fainting-recognition-management-aftercare. Diabetes -hypoglycaemia - hyperglycaemia- management.

Seizures (epileptic fits, convulsions) features- management, stroke. Head injuries-fractures of the base-vault and sides of skull.

Module IV

The circulatory system-heat attack-chest compression- CPR. Shock -causes - signs and symptoms - management of shock.

Eye-eye injuries-foreign body in eye-eye trauma-corrosive chemical in eye-arc eye. Wounds-bleeding-classification-types of wounds-case of wounds-bleeding from special sites.

Fractures- classification of fractures-principles of immobilisation- sprains and dislocation. Broad and narrow fold bandages-hand bandages-slings.

The skin. Burns-rule of nines-pure thermal burns. Electric burns. Chemical burns. Radiation burns. Cold burns. Poisoning. Physical fitness. Lifting - casualty handling. Use of stretchers.

References:

1. Jeanne Mager Stellman (ed*)*. Encyclopaedia of occupational health and safety. (Four volumes). (Fourth edition). International Labour Office, Geneva.(1998).
2. The industrial environment - its evaluation and control. DHHS (NIOSH) publication number 74-117, (1973).
3. Clayton, C.D. and Clayton, F. Patty's industrial hygiene and toxicology. Wiley Inderscience, New York. (1981).
4. Gayle Woodside & Dianna Kocurek, Environmental, Safety and Health Engineering, John Wiley & Sons, New York, (1997). :
5. Cantlie, James. First aid to the injured. St John Ambulance Association. (1932).
6. Yudenich,V.V. Accident first aid, Mir Publishers, Moscow. (1986).

19-200-0407 UNIVERSAL HUMAN VALUES

Course Outcomes:

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

1. More aware of themselves and their surroundings (family, society, nature).
2. More responsible in life in handling problems with sustainable solutions
3. Keep human relationships and human nature in mind.
4. Having better critical ability and would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. Apply what they have learnt to their real life.

Module I: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

Purpose and motivation for the course, recapitulation from Universal Human Values-I.

Self-Exploration –what is it? - Its content and process; 'Natural Acceptance' and experiential Validation - as the process for self-exploration

Continuous Happiness and Prosperity- A look at basic Human Aspirations

Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority

Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario

Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Module II: Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'

Understanding the needs of Self ('I') and 'Body' - happiness and physical facility

Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)

Understanding the characteristics and activities of 'I' and harmony in 'I'

Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail

Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

Module III: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship

Understanding the meaning of Trust; Difference between intention and competence

Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship

Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals

Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Module IV: Understanding Harmony in the Nature and Existence -Whole existence as Coexistence

Understanding the harmony in the Nature

Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self regulation in nature.

Understanding Existence as Co-existence of mutually interacting units in all-pervasive space Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module V: Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values, Definitiveness of Ethical Human Conduct

Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

Case studies of typical holistic technologies, management models and production systems Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations. Sum up.

Include practice exercises and case studies to discuss the conduct as an engineer or scientist etc.

References:

1. R R Gaur, R Asthana, G P Bagaria, Human Values and Professional Ethics, 2nd revised edition, Excel Books, New Delhi, 2019
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. A.N. Tripathi, Human Values,, New Age Intl. Publishers, New Delhi, 2004.

19-206-0408 STRENGTH OF MATERIALS LABORATORY

Course Outcomes:

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

1. Describe the method of conducting experiments.
2. Recognize the basic concept of load and deformation characteristics in elastic bodies subjected to different types of loads.
3. Explain the hardness property and the effect of impact load on ductile materials.
4. Interpret the basic concept of load and deformation characteristics in concrete specimens subjected to compressive load
5. Analyze experimental data and arrive at conclusions.

List of Experiments

1. Tension test on mild steel specimen
2. Torsion test on mild steel specimen
3. Test on open coiled and close coiled helical springs
4. Flexure Test on wood
5. Determination of modulus of elasticity of concrete using cylinder specimen
6. Hardness test on ferrous and non-ferrous materials- Brinnel, Vickers and Rockwell hardness
7. Double shear test on mild steel rod
8. Impact tests - Izod and Charpy
9. Compression test on concrete cubes

19-206-0409 ELECTRICAL TECHNOLOGY LABORATORY

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

1. Explain the laws governing electric circuits
2. Interpret the load and speed characteristics of d.c motors
3. Draw the load and speed characteristics of a.c motors
4. Summarize the functions of protective relays and circuit breakers.

List of experiments

1. Verification of Kirchoff's Laws
2. Verification of Superposition Theorem
3. Study of B.H. Curve on C.R.O
4. Measurement of power in an A.C. circuit by 3 ammeter and 3 voltmeter method
5. Load test on a d.c. series motor
6. Speed characteristics of d.c. shunt motor
7. Regulation of a Transformer
8. Load characteristics of a 3 phase induction motor
9. Study of protective relays and circuit breakers.
10. Study of insulation testing and ground testing.

19-200-0501 NUMERICAL AND STATISTICAL METHODS
(Common to all branches)

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

1. Solve algebraic and transcendental equations by numerical methods
2. Solve numerical differentiation and integration problems
3. Compute the mean and variance of a probability distribution including the binomial distribution.
4. Test hypotheses on data

Module1
Numerical solution of algebraic and transcendental equation by - Regula-Falsi method, Newton Raphson's method. Gauss Seidal iteration method to solve a system of equations and convergence (without proof) Newton's forward and backward interpolation formula. Lagrange interpolation, Newton's divided difference and central differences.

Module2
Numerical differentiation at the tabulated points with forward, backward and central diffrences. Numerical integration with trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule. Taylor series method. Euler method, Modified Euler method, Runge–Kutta method of second and fourth order for solving 1st order ordinary differential equation.

Module3
Random variable (discrete and continuous) Expectation-mean and variance of probability distribution. Binomial, Poisson and Normal distribution and Fitting of this Distribution to the given data. Curve fitting-fitting of straight line, parabola, exponential.

Module4
Population and Sample-Sampling Distribution (of mean and variance) Testing of Hypothesis-level of significance, Z-test statistic, Chi square test for variance, for goodness of fit and F-test .

References:

1. Erwin Kreyzig. Advanced engineering mathematics. (Tenth edition). John Wiley & Sons, Hoboken, N.J. (2010).
2. Grewal, B.S. Higher engineering mathematics. (Forty third edition). Khanna Publishers, New Delhi. (2013).
3. Kandaswamy, P. Thilagavathy, K. and Gunavathy, K. Numerical methods. S Chand &Co, New Delhi. (2007).
4. Richard A. Johnson. Irvin Miller and John E. Freund. Probability and statistics for engineers. (Eighth edition). Pearson, New Delhi. (2010).

19-206-0502 CHEMICAL TECHNOLOGY AND REACTION ENGINEERING

Course Outcomes:

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

1. Describe the manufacturing methods for heavy chemicals, fertilizers, organic chemicals and polymers.
2. Explain the importance of physical, chemical and physico – chemical transformations of the material in process industries.
3. Solve problems using the integral method and differential method of analysis.
4. Compute the volume of Batch, CSTR and PFR reactors using design equations

Module I

Inorganic chemical technology: Chlor-alkali industries-soda ash-caustic soda-chlorine-hydrochloric acid. Manufacture of sulphuric acid. Phosphorous industries - phosphoric acid-wet process phosphoric acid, single super phosphate and triple super phosphate. Nitrogenous industries- ammonia, nitric acid, urea, ammonium sulphate, ammonium phosphate.
(Only the processes currently in use in industries need be covered)

Module II

Organic chemical technology: Manufacturing processes for pulp and paper, sugar, industrial alcohol by fermentation-absolute alcohol, beers, wines, oils and fats, soaps and detergents, agrochemicals, introduction to polymers, synthetic rubbers- SBR, neoprene, urethane rubbers.
(Only the processes currently in use in industries need be covered)

Module III

Classification of reactions, variables affecting rate of reaction, definition of reaction rate. Kinetics of homogeneous reactions – concentration dependent term of a rate equation, temperature dependent term of a rate equation, theories of reaction – collision theory, transition theory, Arrhenius equation. Analysis of experimental reactor data, evaluation of rate equation, integral and differential analysis for constant variable volume system.

Module IV

Ideal reactors- Design for homogeneous systems, batch, stirred tank and tubular flow reactor, design of reactors for multiple reactions, combination reactor system, size comparison of reactors. Elementary ideas of non-ideal reactor performance, residence time distribution curves E, F and C.

References:

1. Gopal Rao, M. and Sittig, M (Eds). Dryden's outlines of chemical technology for the 21st century. (Third edition). Affiliated East West Press, New Delhi. (2010).
2. George T. Austin. Shreve's chemical process industries. (Fifth edition). McGraw- Hill Book Co Inc., New York. (1984).
3. Shukla, S.D. and Pandey, G.N, Text book of Chemical Technology, Vol.I. (1977).
4. Levenspiel, O. Chemical reaction engineering. (Third edition). Wiley India Pvt. Ltd., New Delhi. (2010).
5. Scott Fogler, H. Elements of chemical reaction engineering. (Fourth edition). Prentice-Hall of India, New Delhi. (2005).
6. Smith J.M. Chemical Engineering Kinetics, (Third edition), McGraw Hill, (1981).

19-206-0503 PRINCIPLES OF ENGINEERING DESIGN

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

1. Design threaded fasteners and detachable joints.
2. Design non-detachable joints such as riveted and welded joints
3. Design springs and power shafts
4. Design pipe lines, pressure vessels, storage tanks and their supports.

Module I
Introduction to design- steps in design- design factors- practical considerations in design- theories of failure- stress concentration - consideration of creep and thermal stress in design.

Detachable joints- design of screws- thread standards- thread stress- pre-loading of bolts- external load with pre-load -fatigue and shock loading- Types of keys- types of pins- design of cotter and pin joint.

Module II
Riveted Joints-stresses in riveted joints- design of riveted joints subjected to central & eccentric loads- boiler and tank joints - structural joints.

Welded joints-types of welded joints- design of welded joints subjected to axial, torsion and bending loads.

Module III
Springs- stresses in helical spring- deflection of helical compression and extension Spring- springs subjected to fatigue loading- concentric and helical torsion spring - critical frequency of springs- leaf springs- design of automotive leaf springs.

Power Shafting- Design for static loads- combined stresses- design of shaft for strength and deflection- axial load on shaft.

Module IV
Design of cylindrical and spherical pressure vessels for internal and external pressures- design of heads and enclosures- tall vessels- supports for vessels- pipeline design. Design of storage tanks.

References:
1. Budynas, R.G. and Nisbett, K. Shigley's Mechanical Engineering Design. (Tenth edition). Mc Graw Hill Book Co., New York. (2014).
2. Bhandari, V.B. Design of machine elements. Tata McGraw – Hill Education, New Delhi. (2010).
3. Myatt Donald, J. Machine design: an introductory text, McGraw Hill, New York. (1962).
4. Mahajani, V.V. and Umarji, S.B. Joshy's Process equipment design. (Fifth edition). Trinity Press, New Delhi. (2014).
5. Brownell, L. E and Young, E. H. Process equipment design, John Wiley & Sons, New York. (1995).
6. Bhattacharya, B.C. Introduction to chemical equipment design - Mechanical aspects. CBS Publishers and Distributors, New Delhi. (2003).

Codes and Data Hand Books allowed for reference during examinations

1. IS 2825:1969 - Code for unfired pressure vessels
2. Narayana Iyengar B. R, Lingaiah K., Machine Design Data Handbook, Vol. I &II
3. P.S.G., Tech., Machine Design Data Handbook
4. Mahadevan K., Balaveera Reddy K. Design Data Handbook for Mechanical Engineers, 3rd Edition, CBS Publishers & Distributors. (2013).

19-206-0504 STRUCTURAL FIRE SAFETY

Course Outcomes:

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

1. Explain the behaviour of compartment fire at the pre-flashover and post-flashover stages.
2. Interpret the effect of fire on structural and non-structural materials used for construction.
3. Summarize the method of fire resistance test on structural and nonstructural members, and the method of combustibility tests on building materials.
4. Calculate the fire resistance rating of a compartment and design it for a required fire resistance rating.
5. Determine the method of fire protection to structural members made of different materials and their repair methods if damaged due to fire.
6. Implement the design concept of fire walls, fire screens, local barriers and fire doors in selecting them appropriately for a given fire scenario.

Module I

Compartment fire-factors controlling fire severity, ventilation controlled and fuel controlled fires. Pre-flashover compartment fire- growth period and definition of flashover, conditions necessary for flashover, fuel and ventilation conditions for flashover, factors affecting time to flashover, factors affecting growth. Post flashover compartment fire- regimes of burning, fully developed fire behavior, temperatures achieved in fully developed fire, fire resistance and fire severity, methods of calculating fire resistance, projection of flames from burning compartments, spread of fire from compartments. Compartment temperature-time response at pre-flashover and post flashover periods; Equivalence of fire severity of compartment fire and furnace fire;

Module II

Effect of temperature on the properties of structural materials- Thermal data for concrete, steel, aluminium, masonry and wood; Mechanical properties of concrete, steel, aluminium, masonry and wood exposed to elevated temperatures(Material data); Constitutive stress-strain models for steel and concrete.; Fire protection of structural members made of steel, RCC and wood.

Fire resistance test on structural elements-standard heating condition, types of furnaces, Indian standard test method, performance criteria, drawbacks to the fire resistance test. Approximate calculation of the fire resistance of a compartment; Method of arriving at the required fire resistance of structural members as per Indian Standard Specifications (BIS).

Module III

Determination of combustibility of materials by fire tube method; Brief description on non-combustibility test as per BIS; Behaviour and performance of fabricated fire proof boards- Calcium silicate, Gypsum, Vermiculite, and Perlite boards.

Behaviour of non-structural materials on fire- plastics, glass, textile fibers, geopolymers and other house hold materials. Classification of materials based on surface flame spread and their suitability.

Reparability of fire damaged structures- Assessment of fire severity, Assessment of damage to concrete, steel, masonry and timber structures, Assessment of feasibility of repair; Repair techniques- repair methods to reinforced concrete Columns, beams and slabs, Repair to steel structural members, Repair to masonry structures.

Module IV

Fire area- calculation of building fire area, subdivision of fire areas in Industrial, Residential and Public buildings; Fire separation between building-principle of calculation of safe distance.

Design principles of fire resistant walls and ceilings; Fire resistant screens-solid screens and water curtains; Local barriers; Fire stopped areas-in roof, in partitioned fire areas, and in connecting structures;

Fire doors- Low combustible, Non-combustible and Spark-proof doors; method of suspension of fire doors; Air-tight sealing of doors; Specification, test and performance criteria of Plate, Metal covered and rolling type fire doors as per BIS.

References:

1. Smith, E.E. and Harmathy, T.Z. (Editors), Design of buildings for fire safety. ASTM Special Publication 685, American Society for Testing and Materials, Boston, U.S.A. (1979).
2. Butcher, E. G. and Parnell, A. C. Designing of fire safety. John Wiley and Sons Ltd., New York, U.S.A. (1983).
3. John A. Purkiss Fire safety engineering design of structures (2^{nd} edn.), Butterworth-Heinemann, Oxford, U.K. (2009).
4. Andrew H Buchanan. Structural design for fire safety, John Wiley & Sons Ltd., England. (2001).
5. Dougal Drysdale. An Introduction to Fire Dynamics, (2^{nd} edn.), John Wiley & Sons Ltd., England. (1999).
6. Roytman, M. Ya. Principles of fire safety standards for building construction. Amerind Publishing Co. Pvt. Ltd., New Delhi. (1975).
7. Relevant Indian Standard Code of Practices(BIS)

SE 19-206-0505 MANUFACTURING PROCESSES

Course Outcomes:

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

1. Describe the process of production of various engineering materials and also converting the raw material into parts.
2. Classify the various materials and manufacturing process, non-conformities and testing methods.
3. Determine the property modification processes like alloying and heat treatment of metals and the suitable manufacturing process for various applications.
4. Differentiate the various materials, property modification processes and manufacturing process and select suitable ones for specific requirements.

Module I

Engineering Materials: - Classification, Properties - mechanical, thermal, chemical and technological. Iron and Steel-Processes and Classifications. Non-ferrous metals, processes, properties and use. Heat treatment of steels- purpose and methods. Processes-annealing, normalising, hardening, tempering.

Module II

Welding:-Introduction, weldability, Types of welding, Gas welding, Arc welding - submerged arc, TIG, MIG. Resistance welding, solid state welding, Electron beam welding, Laser beam welding. Oxygen cutting. Heat affected zones, Weld defects, Inspection of welded joints.

Module III

Metal Casting:- Pattern- pattern materials, types of patterns, pattern allowance, Moulding sands-properties and classification. Core and core sands. Moulding process. Special casting methods-die casting, centrifugal casting, investment casting, slush casting. Casting defects and inspection.

Module IV

Metal Forming: - Mechanical working of metals. Hot working, cold working. Methods and process of rolling, forging, and extrusion.

Machining:- Metal cutting, Orthogonal and Oblique cutting, Cutting tool materials. Classification of machine tools - lathe, shaper, milling machine, drilling machine and grinding machine. Advanced machining methods- ECM, EDM, USM, AJM.

References

1. Kalpakjian, S. and Schmid S.R. Manufacturing Engineering and Technology, (Sixth edition). Pearson Education Asia. (2009).
2. Sharma P.C. A Text Book of Production Technology. S. Chand & Co, New Delhi. (2007).
3. Welding Handbook: Vol. I to V. American Welding Society.
4. Hein, Lopper. and Rosenthal. Principles of Metal Casting. (Second edition). McGraw Hill Education (India) Private Limited. (2001).
5. Peter Beeley. Foundry Technology. (second edition). Butterworth-Heinemann. (2001).

19-206-0506 DISASTER MANAGEMENT

Course Outcomes:

On completion of this course the student will be able to

1. Explain Emergencies and controls, with examples of industrial disasters and their consequences.
2. Describe the elements of emergency planning and preparedness.
3. Summarize the causes of natural disasters, mitigation of their effects, rescue, relief and rehabilitation.
4. Explain the disaster management mechanism and capacity building concepts

Module I

Importance of disaster management– Types of emergencies – major industrial disasters – Causes and consequences of Flixborough, Seveso and Bhopal. Components of a major hazard control system – identification of major hazard control installations – purpose and procedures – safe operation of MH installations – mitigation– reporting. Implementation of major hazard control systems – experts – training – checklists – inspection – evaluation – information to the public – manpower requirements – Sources of information.

Module II

Emergency planning – on-site and off-site emerg0ency plan – need of plan – possible approach – objectives of emergency plan. On-site emergency planning – formulation of the plan and emergency services – Identification of resources – actions and duties – emergency procedure – mock drills. Off-site emergency planning – objectives and elements of off-site plan – role of administrative machinery – role of major hazard works management – role of the local authority.
Requirements of emergency plan as per Indian legislations like Factories Act, Manufacture, Storage and Import of Hazardous Chemicals Rules, Chemical Accidents (Emergency planning, Preparedness and Response) Rules. Emergency planning and preparedness in international standards like ISO 14001, OHSAS 18001 and OSHA's Process Safety Management System,

Module III

Natural Hazards – potentially hazardous natural phenomena – earthquakes – landslides – flooding – cyclones – hazards in arid and semi-arid areas.
Understanding Disaster: Concept of Disaster – Different approaches- Concept of Risk – Levels of Disasters – Disaster Phenomena and Events (Global, national and regional). Hazards and Vulnerabilities: Natural and man-made hazards; response time, frequency and forewarning levels of different hazards – Characteristics and damage potential or natural hazards; hazard assessment – Dimensions of vulnerability factors; vulnerability assessment – Vulnerability and disaster risk – Vulnerabilities to flood and earthquake hazards.

Module IV

Disaster Management Mechanism: Concepts of risk management and crisis managements – Disaster Management Cycle – Response and Recovery – Development, Prevention, Mitigation and Preparedness – Planning for Relief.
Capacity Building: Capacity Building: Concept – Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk– Legislative Support at the state and national levels
Planning for disaster management: Strategies for disaster management planning – Steps for formulating a disaster risk reduction plan – Disaster management Act and Policy in India – Organizational structure for disaster management in India

References:

1. ILO, Geneva. Major Hazard Control – a Practical Manual. (1988).
2. Mrinalini Pandey, Disaster Management, Wiley. (2014).
3. Manual on Disaster Management, National Disaster Management Agency, Govt. of India.
4. T. Bhattacharya. Disaster Science and Management, McGraw Hill Education (India) Pvt Ltd. (2015).
5. N. Pandharinath, CK Rajan Earth and Atmospheric Disasters Management, BS Publications. (2009).
6. National Disaster Management Plan, Ministry of Home affairs, Government of India (http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf)

19-206-0507(IE) AVIATION SAFETY AND SAFETY OF SPACE MISSIONS

Course outcomes:

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

1. Demonstrate knowledge of basic aviation safety principles.
2. Demonstrate knowledge of human factors and crew resource management principles
3. Demonstrate knowledge of safety systems in space missions
4. Demonstrate the importance of protecting the space environment

Module I

Aviation Safety Program Management: Accident Prevention Concepts - Management Concept and Safety Program Organization - Reporting and Information Systems - Safety Committees - Safety Inspections and Audits - Safety Management Systems (SMS)

Flight Safety: Issues Related to Flight Safety - ATC Safety.

Ground Safety: Aviation Maintenance Safety - Ground Safety

Module II

Human Factors: Communication – Stress - Situational Awareness - Hazardous Attitudes - Crew Resource Management – Leadership - Teamwork

Aircraft Accidents: Accident Investigation Procedures - Accident Causation Models

Module III

Safety Process, Quality and Reliability - Safety Analyses - Human Ratings - NASA and ISRO Requirement - Failure Tolerance - Design for Minimum Risk - Electrical and Power Systems & Battery Safety - Life Support Systems - Avionics Safety - Software System Safety - Propulsion Systems Safety - Structures and Mechanisms Systems Safety - Non-Destructive Evaluation - Pyrotechnic Devices Safety - Bioastronautics and Crew Escape Systems.

Module IV

Extravehicular Activity and Docking Systems Crew Systems (Flight Suits, Seats) - Oxygen Systems - Toxic Environment - Fire - Launch Vehicle Design - Risk to Public Considerations - The Space Environment: Micro Meteoroid and Orbit Debris (MMOD), Space Traffic Management, Space Radiation Effects - Ground Processing Environment - Flight Operator and Crew Training as Safety Controls - Probability Risk Assessment - Crew Survivability Report

References:

1. Ferguson, M.D. & Nelson, S., Aviation Safety: A Balanced Industry Approach. Delmar Cengage Learning, 2014.
2. Gary Eugene Musgrave, Axel (Skip) M. Larsen and Tommaso Sgobba (Ed). Safety Design for Space Systems. Butterworth-Heinemann, 2009.
3. IAASS-SSI-1700 Commercial Human-Rated System, SAE Aerospace Standard, Issued 2018-07.

19-206-0508 SAFETY IN FIREWORKS INDUSTRY

Course Outcomes:

On completion of the course the students will be able to:

1. Choose the properties of various chemicals used in fireworks industry
2. Recall the concepts of earthing and legal requirements
3. Improve the process safety in fireworks industry
4. Use the proper material handling techniques / equipments
5. Control the wastes and ensure the human safety in fireworks

Module I

Properties of fireworks chemicals: Fire properties – potassium nitrate (KNO_3), potassium chlorate ($KClO_3$), barium nitrate ($BaNO_3$), calcium nitrate ($CaNO_3$), Sulphur (S), Phosphorous (P), antimony (Sb), Pyro Aluminum (A1) powderReactions-metal powders, Borax, ammonia (NH_3) – Strontium Nitrate, Sodium Nitrate, Potassium per chloride. Fire and explosion, impact and friction sensitivity.

Module II

Static charge and dust: Concept-prevention-earthing-copper plates-dress materials-static charge meter lightning, Causes effects-hazards in fireworks factories-lightning arrestor: concept-installation-earth pit-maintenance resistance-legal requirements-case studies.

Dust: size-desirable, non-respirable-biological barriers-hazards-personal protective equipment, pollution prevention.

Module III

Process safety: Safe-quantity, mixing-filling-fuse cutting – fuse fixing – finishing – drying at various stages-packing, storage-hand tools-materials, layout: building - distances- factories act – explosive act and rules – fire prevention and control – risk related fireworks industries.

Module IV

Material handling, transportation and user safety: Manual handling – wheel barrows-trucks-cycles-automobiles-fuse handling – paper caps handling-nitric acid handling in snake eggs manufacture-handling the mix in the factory-material movement-godown-waste pit.

Packing-magazine-design of vehicles for explosive transports loading into automobiles-transport restrictions-case studies-overhead power lines-driver habits-intermediate parking-fire extinguishers - loose chemicals handling and transport.

Concepts of wastes – Wastes in fireworks-Disposal-Spillages-storage of residues. Consumer anxiety hazards in display-methods in other countries-fires, burns and scalds-sales outlets-restrictions-role of fire service.

References:

1.Ronald Lancaster, Roy E.A. Butler, J. Mark Lancaster and Takeo Shimizu, Fireworks Principles and Practice, 4th Edition, Chemical Publishing Company, New York, 2006.

2. John Barton, Dust Explosion Prevention and Protection, Institution of Chemical Engineers, UK, 2002.

3. Michael S. Russell, The Chemistry of Fireworks, Royal Society of Chemistry, UK, 2009.

4. Geoffrey Lunn, "Guide to Dust Explosion Prevention and Protection", Institution of Chemical Engineers, UK, 1992

5. Proceedings of National conference on Pyro Tech 2013, Petroleum and Explosives Safety Organization (PESO), Ministry of Explosives, Government of India, 2013.

6. Bill Ofca, Fireworks Safety Manual: A Collection of Essays. ,Hyde Park, New York, 1990

19-206-0509 INTRODUCTION TO PROCESS PLANT SECURITY AND INFORMATION SECURITY

Course Outcomes:

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

1. Assess the security threats to process plants
2. Summarise the essential elements of site security for process industries
3. Appreciate the value of information to the modern organisation
4. Appreciate the difficulties that arise when valuable information needs to be shared

Module -I

Security for chemical process industries - Assessments and regulatory environment, methods for assessing security vulnerability, emerging security regulations, government development and industry activities that relate to security for process facilities. Strategies and counter measures – prevention of intentional releases and theft of chemical releases at process facilities.
Security Risk in Process Industries – Ethical, Technical and Economic aspects of security risk.

Module-II

Site security for process industries – Essential elements – threat analysis, security counter measures, mitigation and emergency response. Specific security measures – information security, cyber security, physical security, policies and procedures, training, mitigation and response, inherently safer processes. Case study.

Module -III

Information Concepts and Processing: Definition of Information, quality and value of information, categories of Information in business organization level of information, storage and retrieval of data, comparison of manual and electronic storage of data, Organization of data as files, Data Extraction, Transformation and Processing. Electronic digital computer, the number system (binary, digital, octal and hexadecimal and their inter conversions), character code (ASCII and EBCDIC). Network Infrastructure and its basics: LAN, WAN and MAN; Various network topologies, Network Architectures and Protocols, Network Security Fundamentals

Module-IV

Information Security Evolution: Evolution of Encryption Techniques, Historical Perspective of Information Security, Various Encryption and Decryption Techniques, Stream and Block Cypher introduction, Introduction of Asymmetric and Symmetric Encryption Techniques, Business Continuity Planning and Disaster Planning. Information Technology (Amendment) Act 2008 and its important Sections.

References:

1. Reniers G, Khakzad N, Gelder P V (eds). Security Risk assessment in the Chemical and Process Industry. De Gruyter, 2018.
2. Matt Bishop. Computer Security: Art and Science. Addison-Wesley, 2015.
3. ICAI: Technical Guide on Information systems audit. The Institute of Charted Accountants of India, New Delhi, 2009.

19-206-0510 CHEMICAL ENGINEERING LABORATORY

Course Outcomes:

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

1. Determine the surface characteristics of solid particles
2. Determine the energy requirements for size reduction equipment
3. Calculate the area required for a continuous thickener
4. Compare the efficiency of different types of distillation
5. Determine the physical, chemical and biological characteristics of water and waste water

List of Experiments:

1. Sieve Analysis – To analyse a given sample using a set of standard sieves and thus to determine the specific surface area, the volume surface mean diameter and the mass mean diameter by differential analysis and cumulative analysis.
2. Verification of the laws of crushing in a Ball mill and calculation of critical speed.
3. Study of the working of Plate and frame filter press.
4. Free settling – To find out the drag coefficient of a falling sphere in a fluid and verification of Stoke's law.
5. Sedimentation – To study batch sedimentation of slurry and to determine the area of the continuous thickener.
6. Heat transfer from steam to air – Determination of overall heat transfer coefficient.
7. Verification of material balance equation and Rayleigh's equation for simple distillation.
8. Steam distillation.
9. Leaching – leaching a mixture of salt and sand.
10. Study of the kinetics of chemical reaction in a batch reactor.
11. Adsorption isotherms.
12. Frequency response of first and second order systems.
13. Determination of pH, turbidity, total hardness, total solids and dissolved oxygen of water samples.
14. Determination of BOD and COD of waste water samples.
15. Jar test for determining the optimum coagulant dose for water treatment.

19-206-0511 FIRE SAFETY TRAINING

Course Outcomes:

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

1. Explain the operation of general rope works related to fire fighting and the operation of various fire fighting equipments.
2. Exemplify the function and operation of fire fighting vehicles.
3. Recognize the method of refilling portable cartridge type fire extinguishers.
4. Apply the technique of fighting fire using portable fire extinguishers filled with class A and B extinguishing agents.
5. Explain the method of operation of laying hose line and method of connecting different accessories to the hose line.
6. Describe various fire ground operations in a fire incident.

List of Experiments:

1. Study and demonstrate different types of knots, bend and hitches used in fire fighting.
2. Study and demonstrate the operation of different fire fighting equipment.
3. Study of different fire fighting vehicle.
4. Study on the method of refilling of different portable extinguishers- Water, DCP and Foam based.
5. Fire fighting with different types of portable extinguishers- CO_2, Water, DCP and Foam based.
6. Study of hoses, couplings, landing valves and braches
7. Hose drills (dry) – laying of hose, connecting and disconnecting of hoses, couplings, branches, etc.
8. Table top exercise-scenario based fire fighting.
9. Study of various fire ground operations

19-206-0601 LEGAL ASPECTS OF HSE

Course Outcomes:

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

1. Recognize important legal provisions on safety, health, welfare, social security and environment
2. Explain the principles underlying the above provisions of law and the amendments
3. State the safety provisions of different Acts and Rules and analyse important decided cases
4. Produce compliance checklists

Module I

Factories Act– Definitions, Preliminary, Inspecting staff, Health, Safety, Provisions relating to hazardous processes, Welfare, Working hours of adults, Employment of young persons, Special provisions. **Dock Workers (Safety, Health and Welfare) Act** - Definitions, Powers of inspectors, Power of Govt. to direct inquiry, Obligation of dock workers. Duties of Safety Officers, Reporting of accidents, Emergency Action Plan, Safety Committee.

The salient features of the Occupational Safety, Health and Working conditions Code (OSHWC), 2020.

Module II

Employees' Compensation Act: Definitions, Employer's liability for compensation, Calculation of amount of compensation. **ESI Act and Rules**: Applicability, Definitions and Benefits. **Public Liability Insurance Act and Rules-** Definitions, Calculation of amount of relief, Environmental Relief Fund, Advisory Committee, Powers of District Collector, Extent of Liability, Contribution to Relief Fund.

Module III

Explosives Act: Definitions, Categories of Explosives, General Safety Provisions, Use of Explosives, Grant of license, Notice of Accidents, Inquiry into ordinary and more serious accidents, Extension of definition to other explosive substances. **Explosives Rules**, **SMPV Rules** and **Gas Cylinder Rules (**in brief). **Petroleum Act** with important rules - definitions, safety in the import, transport, storage, license, exemption, notice of accidents.

Module IV

Water Act and **Air Act**: Definitions, powers and functions of Boards, prevention and control of pollution, consent administration. **Environment (Protection) Act and Rules**-Definitions, powers of central government, power of giving directions, authorities. **MSIHC Rules**- Definitions, Duties of authorities, Notification of major accidents, safety Reports, safety audit, on-site & off-site emergency plans, safety information to public.

References:

1. Factories Act, 1948.
2. Dock Workers (SHW) Act, 1986.
3. Latest bare Acts and concerned Rules on social security.
4. Explosives Act and related Rules.
5. Petroleum Act and Rules.
6. Environmental Acts & relevant Rules as above.

19-206-0602 PROCESS INSTRUMENTATION AND CONTROL

Course Outcomes:

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

1. Explain the measurement principles and techniques of measuring temperature and pressure.
2. Compare the methods for the measurement of flow, level, pH and humidity.
3. Interpret the operation of different types of control system
4. Analyse the stability of a control system

Module I

Elements of measurement – Fundamental standards, Quality of measurement, Meaning of measurement, Errors in measuring instruments, Precision and accuracy, Calibration principle, Static and dynamic characteristics of measuring instruments.

Measurement of temperature – Bimetallic and pressure thermometers, Thermocouples, Resistance thermometers, Pyrometer, Calibration.

Pressure and vacuum measurement – Manometers, Measuring element, Absolute pressure measurement, Static accuracy of pressure gauges.

Module II

Flow measurement - Orifice installation, Pitot tube, Area flow meters, Open channel meters.

Level measurement – Direct method, Measurement of level in open and pressure vessels.

Measurement of pH and humidity.

Recording Instruments, Indicating and signalling instruments, Signal transmission, and codes.

Module III

Open loop and close loop systems – Transfer function modelling – block diagram representation of mechanical, thermal and liquid level systems.

Transient response analysis – Time response of first and second order system for impulse and step inputs – Effect of damping factors on transient response – Characteristics of proportional, integral, derivative, PI, PD and PID controllers.

Frequency response method of analysis -Polar Plot — Gain margin, Phase margin.

Module IV

Introduction to stability – Definition via impulse response function – Routh-Hurwitz stability criterion – Nyquist stability criterion. Stability analysis using Bode plot

Control system components – error detectors – modulators and demodulators – Hydraulic controllers – Pneumatic controllers – PLC.

Introduction to computer control in chemical process industry.

References:

1. Patranabis, D. Principles of industrial instrumentation. (Second edition). Tata McGraw-Hill Publishing Company Ltd, New Delhi. (1996*).*
2. Eckman, D. P. Industrial instrumentation. Wiley Eastern Ltd, New Delhi. (1990).
3. George Stephanopolous. Chemical process control: An introduction to theory and practice. Prentice Hall of India Pvt. Ltd. (1990).
4. Coughanowr, C.R. and Koppel, L.M. Process system analysis and control. McGraw Hill, New York. (1998)
5. Katsuhiko Ogata. Modern Control Engineering. Pearson Prentice Hall. (2006)
6. M Gopal. Control Systems *(*3rd Edition) Tata McGraw Hill. (2006).

19-206-0603 CHEMICAL PROCESS SAFETY

Course Outcomes:

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

1. Differentiate inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants.
2. Explain the safety aspects of chemical plant operation.
3. Describe the safety precautions to be taken in the storage and handling of gases
4. State the conditions that lead to reaction hazards and measures to prevent them.

Module I

Safety in the design of chemical process plants :-Design principles – Process design development –types of designs, feasibility survey, preliminary design, flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specifications - reliability and safety in designing – inherent safety – engineered safety - safety during start up and shutdown – safety checks in the design of the equipments – reactor safety - safety in erection and commissioning of chemical plants - non destructive testing methods – pressure and leak testing – emergency safety devices – scrubbers and flares – new concepts in safety design and operation- Pressure vessel testing standards– Inspection techniques for boilers and reaction vessels.

Module II

Safety in the operation of chemical process plants: - Properties of chemicals – Material Safety Data Sheets – the various properties and formats used – methods available for property determination. Operational activities and hazards –standards operating procedures – safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems – effects of pressure, temperature, flow rate and humidity on operations – corrosion and control measures- condition monitoring - control valves – safety valves – pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.

Module III

Safety in the storage and handling of chemicals and gases:-Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief – relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation – pipe line transport – safety in chemical laboratories. Safety provisions like level and flow indicators – alarms, trips – protection of stills, columns and towers from lightening – colour coding for pipe lines and cylinders.

Module IV

Chemical reaction hazards: Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self – heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening, Case studies. Stability and sensitivity tests, Classification of materials with explosive potential, Hazard prediction by thermodynamic calculations, Prevention and control of explosions and detonations – diluting a

release, purging and inserting, venting, explosion relief, flame arrestors, explosion suppression, Classification of hazardous areas.

References:

1. Ralph King and Ron Hirst. King's safety in the process industries. Arnold, London. (1998).
2. Industrial Environment and its Evolution and Control, NIOSH publication. (1973).
3. National Safety Council. Accident prevention manual for industrial operations. Chicago. (1982).
4. Lewis, Richard. J., Sr. Sax's dangerous properties of materials. (Ninth edition). Van Nostrand Reinhold, New York. (1996).

19-206-0604 LIFE SAFETY IN BUILDING FIRE

Course Outcomes:

1.On completion of this course the students will be able to:

2.Plan and design evacuation route and exits based on the concepts of human behaviour under emergency movement.

3.Explain the effect of heat and toxic gases from fire on human.

4.Interpret the mechanism of production of smoke due to fire, its harmful effect and movement within a building, and the control measures to be adopted in buildings.

5.Summarize the fire safety requirements for buildings of different occupancy as per the National Building Code of India.

6.Plan, design and distribute various fire safety measures required in buildings of different occupancy type.

7.Explain the method of carrying out fire investigation, arson identification, fire training, fire safety audit and fire risk assessment.

Module I

Process of emergency evacuation- special features of personnel movement, Parameter characteristics of the movement of people; Evacuation exits and routes- stages of evacuation, importance of different stages of evacuation, planning and design of evacuation routes, passages, and exits; calculation of building evacuation time; Planning of seating arrangements in premises where large number of people gather.

Effect of heat exposure to human body, body burns; Toxicity of smoke- effect of harmful agents preventing escape and causing injury or death - CO, CO_2, HCN, SO_2, NH_3, Nitrogen oxide.

Module II

Production of smoke particles, constituents of smoke, quantity and rate of production of smoke, quality of smoke, smoke density, visibility in smoke, smoke movement in buildings; Smoke control in buildings-natural and mechanical ventilation; Design principles of smoke control using pressurization technique; Principles of smoke and explosion vent design; Introduction to zone modeling of compartment fires- pre-flashover and post-flashover fires. National Building Code (NBC) guidelines for general smoke control in buildings; and smoke, fire and explosion venting requirements in industrial buildings.

Module III

Fire prevention measures in buildings as per NBC- Classification of buildings based on occupancy and type of construction, Fire zone; General fire safety requirements applicable to all individual occupancies.

Life safety measures in buildings as per NBC- General exit requirements; Requirements for different types of exit access and exits-doorway, corridors and passageways, horizontal exits, internal staircases, exit passageways, external staircases, ramps; Planning of location and calculation of capacity, number and width of exit as per NBC for different occupancy classification; requirements for compartmentation; requirements of fire detection and alarm system in different occupancies; , firefighting shaft, Fireman’s lift.

Fire protection measures in buildings as per NBC- requirements for portable and fixed fire fighting installations in buildings of different occupancy.

Module IV

Fire safety requirements as per NBC for special occupancy types- Fire safety requirements applicable to all individual occupancies in addition to the general fire safety requirements; additional fire safety requirements for high rise buildings; Special fire safety requirements for Atriums, Commercial kitchens, and car parking facilities

Planning and installation of fire and life safety requirements in different groups of buildings as per relevant codes and standards -Hotel, Schools & Colleges, Hospitals, Theatres, Shopping malls, etc.; Fire protection in underground structures and in buildings under construction.
Fire training and education- fire drill, fire order, guidelines for fire drill and evacuation procedure for high rise buildings as per NBC; Arson- characteristics, method of controlling; Fire Investigation; Fire safety audits; Fire risk assessment.

References:

1. Roytman, M. Ya. Principles of fire safety standards for building construction. Amerind Publishing Co. Pvt. Ltd., New Delhi. (1975).
2. Butcher, E. G. and Parnell, A. C. Designing of fire safety. John Wiley and Sons Ltd., New York, U.S.A. (1983).
3. Jain, V.K. Fire safety in buildings (2^{nd} edn.). New Age International (P) Ltd., New Delhi. (2010).
4. Barendra Mohan Sen. Fire protection and prevention the essential handbook. UBS Publishers and Dist., New Delhi. (2013).
5. Dougal Drysdale. An Introduction to Fire Dynamics, (2^{nd} edn.), John Wiley & Sons Ltd., England. (1999)
6. Relevant Indian Standard Codes of Practice(BIS)

19-206-0605 ENVIRONMENTAL ENGINEERING AND MANAGEMENT

Course Outcomes:

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

1. Summarize the most suitable technique for air pollution monitoring and control for a given application.
2. Recognise the type of unit operations and unit processes involved in wastewater treatment plants
3. Explain the techniques for the disposal and management of urban solid wastes and hazardous wastes
4. Exemplify the tools for environmental management in industries.

Module I

Air pollution- Sources of air pollution, effects of air pollution, classification of pollutants, Atmospheric transport of pollutants-wind profiles, atmosphere stability, inversion, turbulence, dispersion and diffusion of air pollutants, Gaussian plume dispersion model. Principles and techniques of ambient air and stack emission monitoring; Particulate matter control equipment-working principles of gravity settlers , cyclones, wet scrubbers, fabric filters and electrostatic precipitators; Gaseous control methods- an overview of absorption, adsorption and combustion methods; Biological methods for VOC and odour control.

Module II

Physical, chemical and biological characteristic of waste water; Effects of pollutants on water quality and aquatic life; Physical unit operations in waste water treatment- flow equalization, sedimentation, and flotation; Chemical unit processes in waste water treatment- coagulation and flocculation, chemical precipitation and adsorption; Biological unit processes- kinetics of microbial growth, Aerobic treatment systems: working principle and design parameters of trickling filter, activated sludge process, and rotating biological contactor; Anaerobic treatment systems: mechanism of anaerobic process, low rate and high rate digesters, working principle and applications of anaerobic filters and UASB; Biological nitrification –denitrification; Characteristics and treatment methods for the waste water from fertilizer plants, petroleum refineries, pulp and paper mills and distilleries.

Module III

Solid wastes- environmental ,aesthetic and health risk; Sources, quantities and composition of solid wastes; Storage, collection and transportation of urban solid waste, disposal options-sanitary landfills, composting and its variations, anaerobic digestion, incineration and pyrolysis; Vermi composting; Recovery alternative ; Monitoring of solid wastes. Hazardous wastes-definition and classification, health and environmental effects,
treatment, disposal and management of hazardous wastes, legal frame work for hazardous waste management in India.

Module IV

Environmental management in industries- Principles and requirements of ISO 14001 EMS; Environmental auditing and auditing for waste minimization; Environmental impact assessment-description of the environmental setting, prediction and assessment of impacts, methods of impact analysis, Indian scenario, public participation in environmental decision making. Strategies for pollution prevention – recycle and reuse, cleaner technologies. Life cycle assessment – principle and methodology. The concept of industrial ecology.

References:

1. Rao, C.S. Environmental pollution control engineering. New Age International (P) Ltd Publishers, New Delhi. (2007).
2. Rao, M.N and Dutta, A.K. Wastewater treatment, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi. (1987).
3. Metcalf and Eddy Inc. Wastewater engineering: treatment and reuse. *(*Fourth edition*)*. Tata McGraw-Hill Publishing Company Limited, New Delhi. (2003).
4. Canter, L.W. Environmental impact assessment. *(*Second Edition). Irwin / McGraw – Hill, New York. (1996).
5. David, H.F. Liu, I (Ed). Environmental engineers handbook. *(*Second Edition). Lewis Publishers, New York. (1997).

19-206-0606 POWER PLANT ENGINEERING

Course Outcomes:

On completion of this course the student will be able to

1. Recognize the scale and scope of hydroelectric power plants, steam power plants, diesel power plants, gas turbine power plants and nuclear power plants.
2. Describe the complexity of power plants and their components and elements.
3. Summarize the safety issues related to power plants and the current scenario of national and international debates on the same.
4. Explain the basics of various non-conventional energy producing methods.

Module I

Power plant economics – base load and peak load power plants -estimation of load – load curve – load factor – diversity factor – capacity factor – use factor – selection of units – number and size – scheduling operation – cost of energy – depreciation and replacement – economics of plant selection. Hydroelectric power plants – general layout – types of dams – penstock, draft tubes, surge tanks - power house equipment – site selection

Module II

Diesel engine power plant – Layout – Components of a diesel power plant – starting methods – Gas turbine – open and closed cycles – thermodynamics cycles – regeneration – reheating – inter-cooling – efficiency and performance of gas turbines. Combustion chambers of gas turbines – cylindrical – annular and industrial type combustion chamber design– combustion efficiency – advantages and disadvantages. Gas Turbine power plants – classification – elements of a Gas Turbine power plant

Module III

Steam power plants - General layout – fuel handling systems – types of furnaces – stokers – burning systems – types of firing : stokers, pulverized coal burners and fluidized bed combustion - power plant boilers, mountings and accessories - dust and ash handling systems – draft and chimney calculations – condensers – cooling systems - Environmental aspects of thermal power systems. Nuclear power plants - Fundamentals of nuclear fission – reactors – classification – components layout of simple plant – nuclear power safety and waste disposal.

Module IV

Non-conventional energy sources – solar radiation and its measurement – Solar energy collectors – Applications of solar energy - Wind energy conversion – site selection – wind energy collectors – Energy from biomass - ocean energy possibilities and future scope – Ocean Thermal electric conversion (OTEC) – Tidal energy - geothermal energy- Magneto Hydro Dynamic (MHD) power – Fuel cells - thermo electric power - thermionic generation.

References:

1. E.I. Wakil. Power Plant Technology, McGraw Hill education. (2011),
2. P.K. Nag. Power Plant Engineering, Third Edition, Tata McGraw Hill. (2007),
3. Lee J.F. Power Station Engineering and Economy, Tata McGraw Hill.
4. Robert Loftness, Nuclear Power Plants, McGraw Hill.
5. Rai G D. Non-Conventional Energy Sources, Khanna Publishers. (2011),
6. Saravanamuttoo HIH, Rogers GFC, Cohen H, Straznicky PV, Gas Turbine Theory, 6th edition, Prentice Hall. (2008).

19-206-0607(IE) SAFETY IN PETROLEUM AND PETROCHEMICAL INDUSTRIES

Course Outcomes:

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

1. Interpret the various processes employed in petroleum refining and petrochemical industries
2. Estimate the firewater requirement for a petroleum refinery and petroleum depots
3. Recognise the hazards involved in on-shore and off-shore drilling and state control measures
4. Describe the various sources of ignition in process industries and the fire prevention systems employed

Module I

Simplified flow diagrams of a typical refinery – distillation unit, catalytic cracker, reformer, treating unit (hydro forming, gas purification, Sulphur recovery, lubricating oil unit) Simplified flow diagrams of Petrochemical Industry – steam cracking, butadiene extraction, ethane recovery, butyl rubber polymerization.

Module II

Potential fire hazards in petroleum and petrochemical industries (ignition by local sources, spark, flame, hot surface, ignition of oil mists and fumes.). Storage tank farms of petroleum and petrochemical industries – Identification of Hazards, Type of Tanks, Design, Layout, Fire prevention measures including lightning protection. Fire protection arrangements in large tank farms, Design concepts of various fixed fire protection systems like Foam- Water Systems, Halogen & DCP systems. Lock out procedures. Salient features of codes / standards: NFPA, API, OISD and SHELL.

Module III

Fire protection facilities in Oil Refineries, Depots & Terminals- Transportation of petroleum and petrochemical products (safety considerations, statutory considerations). Design and Construction requirements for cross country hydrocarbon pipelines. Liquefied Petroleum Gas (LPG) Bottling Plant Operations. Design Philosophies. Operating Practices- Safety and Fire Protection in bottling plants. Transportation of Bulk Petroleum Products. Storage and Handling of Bulk Liquefied Petroleum Gas.

Module IV

On- Shore and Off- shore drilling. Classification of wells. Drilling method. Rotary drilling. Drilling equipment. Ground and offshore structures for drilling. Offshore platforms and drilling vessels. Drilling mud – functions, classification and properties. Blow-off, well kicks, Blow out preventer. Shallow gas. Directional drilling. Well killing procedure. Emergency shutdown, Methods of Rescue & Fire Fighting. Petroleum and Natural Gas (Safety in Offshore Operations) Rules, 2008.

References:

1. Gopal Rao, M. and Sittig, M (Eds). Dryden's outlines of chemical technology for the 21st century. (third edition). Affiliated East West Press, New Delhi. (2010).
2. Sam Mannan (Editor). Lee's loss prevention in the process industries. (Fourth edition). Butterworth-Heinemann Ltd., UK. (2012).
3. Davorin Matanovic. Nedilika Gaurina– Medjimurec. and Katarina Simon. (Editors). Risk analysis for prevention of hazardous situations in petroleum and natural gas engineering. Engineering Science Reference, Hershey PA. (2014).

4. Aven, T. and Vinnem, J.E. *Risk management with applications from the offshore petroleum industry*. Springer-Verlag, U.K. (2007*).*
*5.*Fire Protection Hand book NFPA. (2008).
6. OISD Standards published by Oil Industry Safety Directorate.

19-206-0608 FOOD AND BIOSAFETY

Course Outcomes:

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

1. Recognise the food additives and food contaminants and their chemical and toxicological properties
2. Recognise the effects of pests on food and the various methods for controlling them
3. Explain the national and international regulations for biosafety.
4. Interpret the environmental, social and ethical implications of biotech applications

Module I

Quality attributes of foods, size and shape, colour and gloss, texture – visual and objectively measurable attributes. Aroma of foods – Introductory ideas, formation and chemistry. Introduction to sensory evaluation of foods and beverages.

Food safety, food additives and food contaminants, their chemical, technological and toxicological aspects, Food laws – development and enforcement. Prevention of Food Adulteration Act and Food Regulations. ISO 9000 series and HACCP. Codex Alimentarius protocols for export.

Module II

Principles of food commodity storage, Insect pests – their biology and food preference. Effects of pests on food commodities. Pesticide classification and chemistry. Pesticide formulations. Pesticide appliances. Insect growth regulators, bio pesticides and grain protectants. Fumigants, Sanitation in food processing / handling units. Ballooning techniques. Irradiation and other physical methods of control. Pesticide and health hazards. Safety devices, pesticide residues in foods, residue analysis and decontamination. Concept of organic foods.

Module III

The legal and socio-economic impacts of biotechnology – Public education of the processes of biotechnology involved in generating new forms of life for informed decision making – Biosafety regulation and national and international guidelines. r-DNA guidelines – Challenges for the Indian biotechnological research and industries – Ethical implications of biotechnological products and techniques.

Module IV

Experimental protocol approvals – Levels of containment – Environmental aspects of biotech applications – Use of genetically modified organisms and their resistance in environment – Special procedures for r-DNA based product production – Social and ethical implications of biological weapons – Good safety practices – GLP standards – Lab contaminants – PI, PII, PIII guidelines.

References:

1. Ronald H. Schmidt and Gary E. Rodrick. Food Safety Handbook. 1st edition, Wiley. (2002).
2. Norman G. Marriott and Robert B. Gravani. Principles of Food Sanitation. 5th edition. Springer. (2006).
3. Sateesh, M.K. Bioethics and Biosafety. I.K. International Pvt Ltd., New Delhi. (2008).
4. Thomas, J. A. and Fuchs, R.L. Biotechnology and Safety Assessment. (3rd Edition). Academic Press. (2002).

19-206-0609 FAULT DETECTION AND DIAGNOSIS

Course Outcomes:

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

5. Recognize the different issues involved in FDD and applications.
6. Explain the design of structured residuals
7. Interpret design of directional structured residuals
8. Summarize advanced level issues and design involved in FDD

Module I

Introduction to Fault Detection and Diagnosis: Scope of FDD:- Types of faults and different tasks of Fault Diagnosis and Implementation - Different approaches to FDD: Model free and Model based approaches. Classification of Fault and Disturbances- Different issues involved in FDD- Typical applications.

Analytical Redundancy Concepts: Introduction- Mathematical representation of Fault and Disturbances: Additive and Multiplicative types – Residual Generation: Detection, Isolation, Computational and stability properties – Design of Residual generator – Residual specification and Implementation.

Module II

Design of Structured Residuals: Introduction- Residual structure of single fault Isolation: Structural and Canonical structures- Residual structure of Multiple fault Isolation: Diagonal and Full Row canonical concepts – Introduction to parity equation implementation and alternative representation.

Module III

Design of Directional structured Residuals: Introduction – Directional Specifications: Directional specification with and without disturbances – Parity Equation Implementation – Linearly dependent column.

Module IV

Advanced level issues and design involved in FDD: Introduction of Residual generation of parametric fault – Robustness Issues –Statistical Testing of Residual generators – Application of Neural and Fuzzy logic schemes in FDD – Case study.

References:

1. Janos J. Gertler. Fault Detection and Diagnosis in Engineering systems. (2nd Edition). Marcel Dekker. (1998).
2. Sachin. C. Patwardhan. Fault Detection and Diagnosis in Industrial Process – Lecture Notes, IIT Bombay. (2005).
3. Rami S. Mangoubi. Robust Estimation and Failure detection. Springer-Verlag, London. . (1998).

19-206-0610 MACHINE SHOP

Course Outcomes:

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

1. Describe the construction of different machine tools: lathe, milling m/c, drilling m/c, grinding m/c, slotting m/c, shaper.
2. Exemplify the various machining operations that can be performed in the above machine tools.
3. Classify the various work holding devices, cutting tools and measuring instruments employed for machining in the above machine tools and use
4. Determine the various cutting parameters for machining and execute them for machining different components.

Details of Experiments:

Introduction to Lathe: Spindle drive - work holding devices - types of Lathe tools - tool holders - tool movement - selection of speeds. Feed and depth of cut - use of cutting coolants - Principle of thread cutting - V-thread and Square thread - thread standards - cutting tool types - grinding of tools - selection of cutting speeds.

Exercises: Exercises involving cylindrical turning, Taper, Turning, Facing, Shoulder turning and curve turning - thread cutting.

Introduction to machine tools like horizontal milling machines, vertical milling machines, slotting and shaping machines, work holding devices- spindle drives- milling cutters - gear milling - surface slot milling - indexing head - simple and differential indexing - grinding wheel - specification and selection - drilling and reaming - capstan and turret lathes - ideas of tool layout.

Exercise: Exercises on lathe - curve turning, multi start thread, drilling and boring, internal thread.

Exercises on milling machines - surface milling and slot and keyway milling, straddle milling, machining of spur and helical gears.

Exercises on - Shaper and slotting - machining of plane and bevel surfaces - keyway and slot machining, exercises on drilling and reaming, surface grinding and tool grinding.

References:

1. HMT. (1986). Production technology. McGraw Hill Education. (1986).
2. Neely. John E. Basic Machine Tool Operations (1st Edition) Prentice Hall. .(1999).
3. Burghardt, Axllered and Anderson. Machine tool operations Part1 & Part 2. 4th Edition McGraw-Hill Book Company.
4. Reddy,Venkart. Workshop Practice Manual, BSP Books. (2014).
5. Goyat S.P. Mechanical Engineering Workshop Practice Laboratory Manual-1, Abhishek Publications,Chandigarh

19-206-0611 COMPUTATIONAL LABORATORY

Course Outcomes:

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

1. Design and draft building fire protection system by Building Information Modelling.
2. Analyse data in safety and fire engineering using spread sheets and statistical software.
3. Estimate quantitative risk using software packages.
4. Recognize the use of different software in solving safety and fire engineering problems.
5. Recognize the use of different software for smoke and fire modelling

List of Experiments:

1. Application of BIM (Building Information Modelling) software for designing and drafting building fire protection systems.
2. Use of spread sheets in computing and graphically representing data in safety and fire engineering.
3. Use of statistical software for safety application –regression, ANOVA, statistical tests of significance.
4. Applications of consequence modelling software in quantitative risk assessment (QRA)
5. Scientific computing using MATLAB to solve safety engineering problems.
6. Application of system simulation in solving plant safety problems.
7. Fire and smoke modelling using open source software.

19-206-0701 HAZARD IDENTIFICATION AND RISK ASSESSMENT

Course outcomes:

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

1. Apply suitable tools for the identification of hazards in a process
2. Explain the various tools used for the quantification hazards and human reliability analysis.
3. Estimate the consequences of fire, explosion and toxic gas release using suitable empirical models
4. Compute the individual and societal risk involved in a process industry

Module I

Hazard and risk, Types of hazards – fire, explosion and toxic gas release, Structure of hazard identification and risk assessment.

Identification of hazards: Inventory analysis, Fire and explosion hazard rating of process plants - The Dow Fire and Explosion Hazard Index, The Mond Index, Plant layout and unit hazard rating, Preliminary hazard analysis, Hazard and Operability study (HAZOP), What If analysis, Case studies.

Module II

Plant availability and process reliability: ways of improving plant availability, MTBF and MTTF, the reliability function, failure rate, bathtub curve, probability relationships, simple reliability estimation.

Estimation of frequency of occurrence of a hazard: The logic tree approach, set theory and Boolean algebra, application to probability, Boolean manipulation.

Fault tree analysis – logic symbols, minimal cut set, logic gates, fault tree quantification.

Event tree analysis – notation, event tree construction, advantages and disadvantages of ETA.

Failure mode and Effect Analysis (FMEA) – methodology, criticality analysis, corrective action and follow-up.

Module III

Consequence modelling:

Source models – discharge rate models, flash and evaporation, dispersion models.

Explosions and fires – vapour cloud explosions, flash fires, physical explosions, BLEVE and fire ball, confined explosions, pool fires, jet fires.

Effect models –dose-response functions, probit functions, toxic gas effects, thermal effects, explosion effects – Software application for effect and damage calculations.

Module IV

Quantification of risk: QRA, Vulnerability analysis, accepted and imposed risk, perception of risk, risk indices, individual risk and societal risk, acceptance criteria for risk, ALARP, Presentation of measures of risk – risk contour, F-N curve. Calculation of individual risk and societal risk.

Human reliability analysis (HRA): factors leading to human error, characteristics of HRA techniques, Technique for Human Error Rate Prediction (THERP), Accident Sequence Evaluation Program (ASEP), Techniques using expert judgment, Operator Action tree (OAT).

References:

1. Sam Mannan (Editor). Lee's Loss Prevention in the Process Industries. (Fourth edition). Butterworth-Heinemann Ltd., UK. (2012).
2. AIChE/CCPS. Guidelines for Chemical Process Quantitative Risk Analysis. (second edition). Centre for Chemical Process Safety, American Institute of Chemical Engineers, New York. (2000).

3. Bob Skelton. Process safety analysis: An Introduction, Institution of Chemical Engineers. (1997)
4. AIChE/CCPS. Guidelines for Hazard Evaluation Procedures. (Second edition). Centre for Chemical Process Safety, American Institute of Chemical Engineers, New York. (1992).
5. L.S.Srinath, Reliability Engineering, Affiliated East-West Press, NewDelhi, (2005).
6. Ian T. Cameron and Reghu. Raman,Process Systems Risk Management, Volume 6 (Process Systems Engineering) Elsevier Academic press, (2005).

19-206-0702 TRANSPORTATION SYSTEMS AND SAFETY

Course Outcomes:

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

1. Explain working of railways and safety aspects in railway operation
2. Recognize basic geometric design features of roads
3. Explain traffic characteristics and prevention of road accidents
4. Summarize the basic layout and facilities of docks and harbours

Module I

Railway Engineering: Permanent way. Curves, super-elevation, negative super-elevation, transition curve, grade compensation on curves. Railway operation & control – points and crossings, turn-out. Signalling and interlocking. Centralized traffic control. Railway accidents & safety. Rapid transit railways - types, merits & demerits.

Module II

Highway Engineering: Classification of highways and urban road patterns. Typical cross section of roads. Factors controlling the alignment of roads. Basic geometric design – stopping and overtaking sight distances.

Module III

Traffic Engineering: Traffic characteristics. Various traffic studies and their applications. Traffic signals. Carriage-way markings. Traffic islands. Highway intersections. Principles of highway lighting. Road Accidents – prevention, investigation and reduction.

Module IV

Harbour & Dock Engineering: Water transportation, classification of harbours, accessibility and size, ports, Indian ports. Layout of ports, breakwater, facilities (in brief) for docking, repair, approach, loading and unloading, storing and guiding.

References :

1. Rangwala, S. C. Railway Engineering. Charotar Book Distributors. (2012).
2. Chandra, S. and Agarwal, M. M. Railway Engineering. Oxford University Press. (2007).
3. Khanna, S. K. & Justo, C. E. G. Highway Engineering *(9th ed)*. Nem Chand & Brothers. (2001). (2004).
4. Kadiyali, L. R. Traffic Engineering and Transport Planning. Khanna Publishers, New Delhi.
5. Srinivasan, R. Harbour, Dock and Tunnel Engineering. Charotar Publishing House Pvt. Ltd. (2013).

19-206-0703 SAFETY IN CONSTRUCTION

Course Outcomes

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

1. Recognize the safety issues at different stages of construction activity.
2. Interpret the safety requirements in various construction operations in framing guidelines to ensure safety at construction site.
3. Interpret the safety requirements in material handling in framing guidelines to ensure safety at construction site.
4. Interpret the safety requirements in the operation and handling of different tools and vehicles in framing guidelines to ensure safety at construction site.
5. Summarize the legal provisions with respect to the health and welfare of workers at construction site.

Module I

Introduction to construction industry and safety issues in construction – Human factors in construction safety management – Roles of various groups and stake-holders in ensuring safety in construction industry – Framing of contract conditions on safety and related matters – Ergonomic risks in construction.

Module II

Safety in the construction of various elements of buildings– Foundations-excavation, piling and other deep foundations; Wall construction; Roof construction; Erection of concrete framed structures; Erection of structural steel work; construction of Temporary Structures; Safety in various construction operation- General safety requirements at work place; Under-pinning & Shoring; Working at height-Use of Ladders and Scaffolds; Tunneling; Blasting; working in confined space; Under-water works; Safety in demolition of buildings; Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety.

Module III

Safety in storage, stacking and handling of common construction materials- Cement, Lime, Masonry units, floor, wall and roof tiles, Aggregates, Timber, steel, Doors, windows and ventilators, Glass sheets, Flammable materials; Safety in the use of construction equipments- hoists and lifts, lifting gears, wire ropes, chain and pulley blocks pneumatic and hydraulic tools, hand held power tools; Safety in the use of construction vehicles/machinery– Movement of people and vehicles, excavators, graders, dozers, mobile and tower cranes, concrete mixers

Different hazards at construction site and their control- Electrical hazard; Fire hazard; Chemical health hazard; Biological health hazard; Physical health hazard; Psychological health hazard.

Module IV

Requirements of habitat for construction workers- site selection, minimum facilities, sanitary facilities, drinking water and first aid facilities

Contract Labour (R&A) Act and Central Rules: Definitions, Registration of Establishments, Licensing of Contractors, Welfare and Health provisions in the Act and the Rules, Penalties, Rules regarding wages.

Building & Other Construction Workers (RE & CS) Act, 1996 and Central Rules, 1998: Applicability, Administration, Registration, Welfare Board & Welfare Fund, Training of Building workers, General Safety, Health & Welfare provisions, Penalties.

References:

1. Phil Hughes and Ed Ferret., Introduction to health and safety at work (2nd edn.), Butterworth-Heinemann, UK. (2007),
2. Helen Lingard and Steve Rowlinson., Occupational health and safety in construction project management, Spon Press, Taylor & Francis Group, London. (2005),
3. Vaid, K.N., Construction safety management. National Institute of Construction Management and Research, Mumbai. (1988).
4. Davies, V. J., and Tomasin, K., Construction safety handbook. Thomas Telford Publishing, London. (1996).
5. The Contract Labour (Regulation and Abolition) Central Rules (1971)
6. Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and Central Rules.
7. Relevant Indian standard codes of practice.

19-206-0704 PRINCIPLES OF INDUSTRIAL MANAGEMENT

Course Outcomes:

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

1. State the concept of organization and management and define the functions of human resources, operations and project management.
2. Exemplify the different types of organization structures and also summarise the role of human resources, operations and project managers.
3. Determine appropriate organization structures for specific applications and also apply the different tools of human resources, operations and project management.
4. Outline the development of scientific management principles, differentiate the organisation structures and theories of motivation, leadership etc.

Module I

Organisation : Concept of organisation, characteristics of organisation, elements of organisation, organisational structure, *organisation* charts, Types of organisation- line & staff organization, functional organisation, project organisation, matrix organisation,

Management: Functions, Evolution of management theory, Principles of scientific management,

Module II

Personnel Management: Motivation theories, Leadership theories and mo On successful completion of the course the student will be aware of dels, Recruitment and training, labour turnover, operator training,

Wages and Incentives: feature of wages, time and piece rate, incentive plans, profit sharing. Job evaluation, Merit rating methods- factors of comparison and point rating-defects.

Industrial Relations: industrial disputes, collective bargaining, trade unions, workers' participation in management, labour welfare.

Module III

Production Management: Production System-Functions-Product Desi On successful completion of the course the student will be aware of gn-Product Life Cycle. Demand forecasting for operations - components of demand - methods of prediction and forecasting - forecasting models – casual & time series PPC-Functions -Models

Capacity Planning - Evaluating future capacity - capacity requirement –Aggregate Planning

Inventory Control-Objectives-Costs-Models: Basic, Production, Shortage-ABC Analysis.

Module IV

Project Management: Project Appraisal - Feasibility Analysis, Market feasibility, Technical feasibility, Financial feasibility, Economic feasibility, Financial and Economic appraisal of a project, Social Cost- Benefit Analysis in India, Project Report. On successful completion of the course the student will be aware of

Project Scheduling: Network Techniques, PERT, CPM, GANTT charts, GERT, Time cost trade off and crashing procedure

References:

1. Kootnz, H Principles of Management. Tata McGraw Hill Education. (2004).
2. Buffa, E.S. Modern Production and Operations Management. (Eighth edition). John Wiley and Sons. (2007).
3. Prasanna Chandra. Projects: Planning, Analysis, Selection, Implementation & Review. (7th edn). Tata Mcgraw Hill, New Delhi. (2009).
4. Martand Telsang., Industrial Engineering and Production management. (3rd edition). S.Chand & Co., New Delhi. .(2014)

19-206-0705(IE) HSE ASPECTS OF FERTILISER INDUSTRY

Course Outcomes:

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

1. Identify engineering problems in fertilizer manufacturing.
2. Suggest measures for occupational health management in fertiliser industry
3. Identify hazards associated with the various activities in fertiliser manufacturing and suggest loss prevention and control measures
4. Summarise the environmental problems in fertiliser industry and identify measures for the prevention and control of these problems.

Module – I

Fertiliser an overview, Types of Fertilisers: (Chemical, Organic & Biofertiliser), Nitrogenous fertilisers, Phosphatic & Potassic fertilisers, Complex fertilisers - Major Raw materials for fertiliser manufacture - Brief Manufacturing Processes for Major fertilisers: Urea, Ammonium Sulphate, DAP, SSP, Complex Fertilisers, Organic Fertiliser (Composting), Biofertiliser - Manufacturing process for major intermediates: Ammonia, Nitric Acid, Sulphuric acid, Phosphoric acid.

Module – II

Occupational Health problems in fertiliser industries - Measures for preventing the occurrence of occupational health issues - Requirements of ISO 9000, 14000 and OHSAS 1800 - Process hazard analysis and risk management - work controls through health protocols - effective occupational health management.

Module –III

Safety in Fertiliser industry - Hazards associated with various fertiliser plant operations - Storage, handling and transport of raw materials and intermediates - Reaction Hazards – Measures for loss control in storage, handling and transport. International and Indian standards for the safe storage, handling, and transport of hazardous chemicals. Disaster preparedness and risk reduction in fertiliser industry. Behavioural safety through mind-set change. Management of hazards associated with highly hazardous chemicals - comprehensive management program that integrates technology, procedures and management practices - PSM assurance through asset integrity - Comprehensive “Management of Change” process - Contractor safety management

Module – IV

Fertiliser industry - Environmental Challenges: Major Pollutants generated in fertiliser manufacturing processes. Pollution Control measures in fertiliser industry. Pollution Prevention strategies in fertiliser industry. Environmental standards applicable to fertiliser industry. Phosphogypsum Challenge. Meeting the challenge of minimizing the pressures on natural resources, reducing the environmental footprint across the value chain and innovating to meet demands for more environmentally sustainable solutions. Global emission legislation. Climate Change: GHG emissions & Reducing the CO_2 footprint.

References:

1. Shishir Sinha, K K Pant and Shailendra Bajpai, Acquisition Ed. J N Govil. Fertilizer Technology I: Synthesis. Stadium Press LLC. 2015.
2. Shishir Sinha, K. K. Pant. Fertilizer Technology-II (Biofertilizers). Stadium Press LLC. 2015.
3. UN Industrial Development Organization, Int'l Fertilizer Development Center. Fertilizer Manual. Springer Science & Business Media, 1998.
4. B. K. Bhaskara Rao, R. K. Jain, Vineet Kumar. Safety in Chemical Plants/Industry and Its Management. Khanna Publishers. 2010

19-206-0706 AUTOMOBILE ENGINEERING AND SAFETY

Course Outcomes:

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

1. Describe the construction of all the sub-systems of an automobile: engine,fuel system, electrical system, transmission system and lubricating system.
2. Exemplify the various sub-systems of an automobile system.
3. Summarise the working of the various sub-systems of an automobile system and explain the fuction of the automobile system.
4. Relate the various provisions of CMV(Central Motor Vehicles) rules pertaining to limiting dimensions, proto-type testing, emission standards, lighting, brakes and safety devices.

Module I

Types of automobiles. Limiting Dimensions as per Central Motor Vehicles Rules. Engines – Classification, Construction, Materials of engine components. Prototype Testing as per Central Motor Vehicles Rules.

Fuel System – Fuel tank, Fuel filter, Types of Fuel system. Carburettor – Simple and Modern, Fuel injection System. Emission Standards as per CMV Rules.

Module II

Electrical System – Storage Battery Operations and Maintenance. Ignition System – Coil and Magneto Ignition System. Starting System, Lighting System, Horn System – Wind Shield Wiper Motors, Fans, Heaters, Traficators. Automobile air conditioning. Central Motor Vehicles Rules regarding Lighting, Windshields, Wipers.

Module III

Transmission System – Clutches – operation and fault finding of clutches, Fluid Flywheel, Gear Box-types, Steering Systems, Chassis Springs, and Suspension. Differential, Dead and Live axles, Rims, Tyre etc. Brakes – Types, construction and fault finding. CMV Rules – Brakes, Steering & Tyre.

Module IV

Lubrication Systems – Types, Components, Lubricating oil, Cooling system – Details of components, Study of Systems, Types. Miscellaneous – Special gadgets and accessories for fire fighting vehicles. Automobile accidents. CMV Rules regarding Safety devices for drivers, passengers.

References:

1. Narang GBS. Automobile Engineering, Khanna Publishers,New Delhi. (2014).
2. Kirpal Singh), Automobile Engineering Vol.I &II.(13th edition) Standard publishers-distributors, New Delhi. (2012).
3. Joseph Heitner. Automotive Mechanics - Principles & Practices.(2nd edition)*CBS* Publishers, New Delhi. (2006).
4. Kohli P.L. Automotive Electrical Equipments. Mcgraw Hill Education, New Delhi. (1993).
5. The Central Motor Vehicles Rules (1989).

19-206-0707 RELIABILITY ENGINEERING

Course Outcomes:

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

1. Recall probability fundamentals and describe different hazard models, simple and complex systems and tools for assessing reliability.
2. Define probability rules& theorems and exemplify standard distribution functions and simple & complex systems and reliability assessing techniques.
3. Compare different hazard models, systems and compute the reliability of complex systems using different tools.
4. Determine reliability, MTTF, MTBF from failure data, implement methods for reliability improvement and differentiate the reliability assessing techniques.

Module I

Reliability: Definition; Probability Concept; Addition of Probabilities; Complimentary Events; Kolmogorov Axioms.

Failure Data Analysis: Introduction, Mean Failure Rate, Mean Time to Failure (MTTF), Mean Time between Failures (MTBF), Graphical Plots, MTTF in terms of Failure Density, MTTF in Integral Form.

Module II

Hazard Models: Introduction, Constant Hazard; Linearly Increasing Hazard, The Weibull Model, Density Function and Distribution Function, Reliability Analysis, Important Distributions and their Choice, Standard Deviation and Variance.

Conditional Probability: Introduction, Multiplication Rule, Independent Events, Vern Diagram, Hazard Rate as conditional probability, Bayes Theorem.

Module III

System Reliability: Series. Parallel and Mixed Configurations, Complex Systems, Logic Diagrams, Markov Models.

Reliability Improvement & Repairable Systems: Redundancy, Element, Unit and standby Redundancy, Optimization; Reliability – cost trade- off, Introduction to Repairable Systems, Instantaneous Repair Rate, MTTR, Reliability and Availability Functions, Important Applications.

Module IV

Fault-Tree Analysis and Other Techniques: Fault-tree Construction, Calculation of Reliability, Tie- set and Minimal Tie-set.

Maintainability and Availability: Introduction, Maintenance Planning, Reliability and Maintainability trade – off.

References:

1. Srinath L.S. Reliability Engineering, Affiliated East-West Press, New Delhi. (2005),
2. Govil A.K. Reliability Engineering, Tata Mc-Graw Hill, New Delhi. (1983).
3. Rao S.S. Reliability Engineering, Pearson Education. (2014),
4. Balagurusamy L. Reliability Engineering,Tata Mc-Graw Hill, New Delhi. (2002),
5. Kapur K.C. and Lamberson L.R., Reliability in Engineering Design, Wiley Publications. (2009).

19-206-0708 INDUSTRIAL PSYCHOLOGY

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

1. Recognize the nature, scope, and challenges of Industrial Psychology
2. Interpret the psychological factors that influence individual differences in behaviour at work
3. Explain the concepts of motivation and job satisfaction
4. Summarize information required to sustain employability

Module I
Introduction to Industrial Psychology:
Nature and Development of Industrial/Work Psychology - Historical background- Scientific Management, Time and Motion Study, Hawthorne Studies, World War I & II. Scope & Challenges: Current status.

Module II
People at Work:
Individual Differences: Personality, Intelligence, Emotional Intelligence, Creativity & Innovation, Perception & Attitudes. Motivation- N-Ach, Expectancy, Equity & Goal Setting Theories, Modern Approach to Motivation: Employee Predisposition, Expectations, Goals, & Incentives
Job Satisfaction- Job Characteristic Theory (Diagnostic Model), Measuring Job Satisfaction
Psychometric Testing at Work- Cognitive Abilities, Personality, Emotional Intelligence.

Module III
Managing People at Work-I
Employee Selection- Techniques, Fair Employment Practices. Recruitment- Biographical Information, Interviews, References & Letters of Recommendation. Job Analysis- Types, Newer Developments.

Module IV
Managing People at Work-II
Performance Assessment: Evaluation & Appraisal- Objective & Subjective Techniques, Bias in Appraisals, Development Plans.
Organizational Training- Types of Training, Psychological Issues. Career Development & Planning.

References:
1. Schultz, D. & Schultz, S. E. Psychology and Work Today: An Introduction to Industrial and Organizational Psychology. 7th Edition. Pearson Education: New Delhi. (2013).
2. Aamodt, M.G. Industrial Psychology. Cengage Learning: Delhi. (2013).
3. Matthewman, L., Rose, A. & Hetherington, A. Work Psychology. Oxford University Press: India. (2009).
4. Landy, F. J. & Conte, J. M. Work in the 21st Century: An Introduction to Industrial and Organizational Psychology. 2nd Edition. Wiley India: New Delhi. (2010).
5. Schultz, D. & Schultz, S. E. Psychology and Work Today. Pearson Education: New Delhi. (2002).

19-206-0709 ENTREPRENEURSHIP AND SMALL BUSINESS DEVELOPMENT

Course Outcomes:

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

1. Recognize different types of entrepreneurial ventures
2. Interpret opportunity and risk analysis
3. Summarize the strategies for valuing their own company, and how venture capitalist and angel investors use valuations in negotiating milestones, influence and control
4. Determine correct marketing mix and how to position the company in the market by using analytical tools
5. Explain how organizations operate and their process matrices

Module I

Market Research: Introduction to Entrepreneurship, Profile of the Entrepreneur, Market Gap /Opportunity Analysis, Market Research Methods, Defining the Focal Market: Market Segmentation, Industry analysing – Research / Competitive Analysis.

Types of Companies and Organizations: Company/ Organization Types, Legal Aspects, Taxation, Government Liaison, Building the Team, Mergers and Acquisitions, import and export nuances.

Module II

Business Finance: Shares and Stakes, Valuation, Finance Creation (Investors / Financers), Revenue Plans and Projections, Financial Ratios, Business Lifecycle, Break Even, Balance Sheets, game theory.

Module III

Marketing: Marketing Basics, Marketing Strategy and Brand Positioning, Plans and Execution Techniques, Marketing Analytics, Online Marketing, Product Life Cycle.

Sales: Understanding Sales, Pitching Techniques, Sales strategies, Inside Sales v/s Outside Sales, RFP

Module IV

Operations Management and HR: Operational Basics, Process Analysis, Productivity, Quality

Start-ups: Start-up Basics, Terms, Start-up Financing, Start-up Incubation, Getting Listed

References:

1. David Kidder. The Startup Playbook: Secrets of the Fastest-Growing Start-ups from their Founding Entrepreneurs

2. Ed Catmull. Creativity, Inc.: Overcoming the Unseen Forces That Stand in the Way of True Inspiration

3. Bhargava, S. Transformational leadership: Value based management for Indian Organizations (Ed.). New Delhi: Response-Sage. (2003).

4. Hisrich, R. D. & Peters, M. P. Entrepreneurship: Starting, developing, and managing a new enterprise (5th Ed.). New York: McGraw-Hill. (2001).

5. Verma, J. C., & Singh, G. Small business and industry: A handbook for entrepreneurs. New Delhi: Response-Sage. (2002).

6. Prasanna Chandra Financial Management: Theory and Practice, Tata McGraw Hills, 6th Edn. (2004).

19-206-0710 SCIENCE AND TECHNOLOGY OF NANOMATERIALS

Course Outcomes:
On completion of this course the student will be able to:
1. Explain methods of fabricating nanostructures.
2. Relate the unique properties of nanomaterials to the reduce dimensionality of the material.
3. Describe tools for properties of nanostructures.
4. Discuss applications of nanomaterials and implication of health and safety related to nanomaterials.

Module I
Introduction of nanomaterials and nanotechnologies, Features of nanostructures, Background of nanostructures, Techniques of synthesis of nanomaterials, Tools of the nanoscience, Applications of nanomaterials and technologies.
Bonding and structure of the nanomaterials, Predicting the Type of Bonding in a Substance crystal structure, Metallic nanoparticles, Surfaces of Materials, Nanoparticle Size and Properties.

Module II
Mechanical properties of materials, theories relevant to mechanical properties, techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterials.

Module III
Electrical properties, Conductivity and Resistivity, Classification of Materials based on Conductivity, magnetic properties, electronic properties of materials, classification of magnetic phenomena.

Module IV
Nano thin films, nanocomposites, new application of nanoparticles in different fields.

References:

1. Massimiliano Ventra, Stephane Evoy and James R. Heflin (Ed). Introduction to Nanoscale Science and Technology (Nanostructure Science and Technology), Springer US. (2004).
2. Guozhong Cao and Ying Wang. Nanostructures and Nanomaterials: Synthesis, Properties, and Applications (World Scientific Series in Nanoscience and Nanotechnology) (Second edition), World Scientific. (2011).
3. Malkiat S. Johal. Understanding Nanomaterials, CRC Press. (2018).

19-206-0711 ENERGY MANAGEMENT AND CONSERVATION

Course Outcomes:

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

1. Calculate the efficiency of various thermal utilities.
2. Design suitable energy monitoring system to analyze and optimize the energy consumption in an organization.
3. Design suitable systems for heat recovery and co-generation to improve thermal efficiency.
4. Relate energy audit methods learnt to identify the areas deserving tighter control to save energy expenditure.
5. Explain to the employees of the organization about the need and the methods of energy conservation

Module I

Energy Scenario :Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, Indian energy scenario, Sectoral energy consumption (domestic, industrial and other sectors), energy needs of growing economy, energy intensity, long term energyscenario, energy pricing, Energy security, energy conservation and its importance, energy strategy for the future, Energy Conservation Act 2001 and its features.

Basics of Energy its various forms and conservation :Electricity basics - Direct Current and Alternative Currents, electricity tariff, Thermal Basics-fuels, thermal energy contents of fuel, temperature and pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity and heat transfer.

Module II

Evaluation of thermal performance: calculation of heat loss - heat gain, estimation of annual heating & cooling loads, factors that influence thermal performance, analysis of existing buildings setting up an energy management programme and use management - electricity saving techniques

Energy Management & Audit: Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering

Module III

Energy Monitoring and Targeting: Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques - energy consumption, production, cumulative sum of differences (CUSUM). Energy Management Information Systems (EMIS)

Module IV

Energy Efficiency in Thermal Utilities and systems: Energy efficiency in thermal utilities like boilers, furnaces, pumps and fans , compressors, cogeneration (steam and gas turbines), heat exchangers ,lighting system, Motors belts and drives, refrigeration system.

Heat Recovery and Co-generation: Heat recovery from ventilation, air co-generation of heat and electricity, heat recovery and bottoming cycles.

References:

1. Kenny W.F. Energy Conservation in Process Industry, Academic Press. (2012).
2. Amlan Chakrabarti. Energy Engineering and Management, Prentice Hall India. (2011).
3. Smith C.B. and Parmenter K. Energy Management Principles (Second edition), Elsevier. (2015).
4. Hand outs, Bureau of energy efficiency, New Delhi.
5. Turner W. C. and Steve Doty. Energy Management Hand Book (Sixth edition), The Fairmount Press Inc. (2007).

19-206-0712 FIRE ENGINEERING LABORATORY

Course Outcomes:

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

1. Explain the method of determination of flash Point, fire point and pour point of hydrocarbon liquids.
2. Summarize the effect of temperature on the viscosity of hydrocarbon liquids
3. Test the quality and hence the acceptability of DCP and AFFF in fighting fire.
4. Test the performance and hence the acceptability of portable fire extinguishers in fighting fire.
5. Explain the effect of temperature on the strength of building materials
6. Interpret the method of determination of the flame spread rate of materials.
7. Explain the method of determination of the combustibility of building materials.

List of Experiments:

1. Determination of flash Point, fire point and pour point of hydrocarbon liquids.
2. Study on the effect of temperature on the viscosity of hydrocarbon liquids using redwood viscometer.
3. Physical tests on Dry Chemical Powder as per relevant Indian standard specifications
4. Physical tests on AFFF as per relevant Indian standard specifications
5. Performance Tests on Portable Fire Extinguishers – AFFF, water and DCP type
6. Determination of flame spread rate of materials
7. Study on the effect of temperature on strength of building materials – Concrete and masonry units.
8. Rebound hammer test on concrete exposed to elevated temperatures.
9. Test of non-combustibility of Building Materials.

19-206-0713 INDUSTRIAL HYGIENE LABORATORY

Course Outcomes:

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

1. Estimate the different pollutants in the atmosphere using air sampling equipment.
2. Compute heat stress in industries.
3. Determine the noise level in industries.
4. Determine the illumination level in working environment.
5. Interpret the different body movements.

List of Experiments:

1. Study of Personal Protective equipment
2. Study of occupational diseases with photographic models.
3. Study of different body movements
4. Demonstration of Air sampling equipment.
5. Sampling and estimation of dusts using high volume sampler
6. Sampling and estimation of dust using personal sampler
7. Measurement of Noise
8. Measurement of illumination
9. Vision testing
10. Lung function testing.
11. Measurement of thermal stress.

19-206-0714 ENTREPRENEURSHIP DEVELOPMENT

Course Outcomes:

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

1. Recognize importance of entrepreneurship opportunities available in the society
2. Summarize the challenges faced by the entrepreneur

Exercises:

1. To study the types of entrepreneurs and the factors affecting entrepreneurial growth.
2. To make an assessment of the major motives influencing an entrepreneur
3. To make an overview of the various stress management techniques
4. How to identify and select a good business opportunity?
5. Preparation of a techno economic feasibility report for a given project
6. Preparation of a preliminary project report for a given project
7. To identify the various sources of finance and management of working capital
8. Carry out the costing and break even analysis of a proposed project
9. Preparation of a PERT / CPM chart for the various activities involved in a project
10. To make a study of the various causes and consequences of sickness in small business and identify corrective measures.

References:

1. Roy Rajeev. Entrepreneurship. (Second edition). Oxford University Press, New Delhi. (2011).
2. Gordon, E. and Natarajan, K. Entrepreneurship development. (Fourth edition). Himalaya Publishing House, New Delhi. (2007).
3. Coulter Mary. Entrepreneurship in action. (Second edition). PHI Learning, New Delhi. (2008).
4. Jain, P.C. Handbook for new entrepreneur. Oxford University Press, New Delhi. (2003).
5. Khanka, S.S. Entrepreneurial development. (Fifth edition). S. Chand and Co, New Delhi. (2013).

Note: There will only be continuous evaluation for this course. The evaluation will be based on the performance of the student in the exercises given. A minimum of 50% marks is required for a pass.

19-206-0715 PROJECT PHASE – I

The students shall identify a suitable project in consultation with the project guide. A thorough literature review shall be carried out to identify the gaps. The objectives for the project shall be formulated and the methodology for doing the work shall be finalised in Phase –I. Evaluation shall be carried out based on the extent of work carried out and a presentation.

19-206-0716 INDUSTRIAL INTERNSHIP

Course Outcomes:

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

1. Recognise the importance of safety in industrial environment.
2. Coordinate interaction with interest groups, disciplines, professionals, managers, technicians etc.
3. Summarize the safety precautions to be taken in day-to-day operation, troubleshooting and minor-modifications.
4. Recognize the need for University-Industry interaction and mutual cooperation over long-term.

Every Student shall undergo An industrial internship of minimum two weeks duration in a petroleum/ oil & gas industry/ chemical industry/engineering industry/ construction site/power plant/fire & rescue department of the States after IV Semester and before the commencement of the VII semester and submit a report. The evaluation of internship will be conducted along with Project Phase I.

19-206-0801 HAZARD CONTROL IN MANUFACTURING

Course Outcomes:

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

1. Describe the various manufacturing processes- hot & cold working of metals, metal cutting, welding & cutting, heat treatment methods, and material handling methods and the equipment and machineries employed in engineering industries.
2. Summarise the various hazards associated with different manufacturing processes, heat treatment methods and material handling methods.
3. Evaluate the various hazards, relate to the hazard control principles and determine the different hazard control measures.
4. Differentiate various hazards identified and suggested hazard control methods.

Module I

Introduction - Classification of Engineering Industry –Manufacturing Processes

Hot Working-Foundry operations-furnace and equipment, health hazard, safe methods of operation. Forging operations, heat radiation, maintenance of machines, shop equipment and hand tools - safe work practice. Operations in hot and cold rolling mills.

Module II

Machinery safeguard-Point-of-Operation, Principle of machine guarding - breakdown of machine guarding - types of guards and devices.

Cold Working-Safety in Power Presses, primary & secondary operations - shearing -bending - rolling – drawing. Metal Cutting- safety in turning, boring, milling, planning and grinding. Maintenance of machine tools - health hazards and prevention.

Module III

Welding and Cutting-Safety Precautions of Gas welding and Arc Welding, Cutting and Finishing. Gas Cylinders and Equipment's. Heat Treatment- Furnaces and Salt baths-operations and maintenance -safety in handling and storage of salts- disposal of effluents - health precautions, exposure to hazardous fumes, source of fumes, ventilation and fume protection.

Module IV

Material Handling-Classification-safety consideration- manual and mechanical handling. Handling assessments and techniques- lifting, carrying, pulling, pushing, palletizing and stocking. Material Handling equipment-operation & maintenance. Maintenance of common elements-wire rope, chains slings, hooks, clamps .

References:

1. National Safety Council, ChicagoAccident prevention manual for industrial operations. (1982).
2. Ronald P. Blake. Industrial safety. (3rd edition) Prentice Hall, New Delhi. (2000).
3. Balchin, N.C. Health and Safety in Welding and Allied process, Jaico Publishers, New Delhi. (2005).
4. Kalpakjian, S and Schmid S.R. Manufacturing Engineering and Technology, (Sixth edition). Pearson Education Asia. (2009).

SE 19-206-0802 TOTAL QUALITY MANAGEMENT

Course Outcomes:
On completion of this course the student will be able to:
1. Recall statistical fundamentals and describe the basic concepts, principles and tools of TQM.
2. Exemplify the principles of TQM, the seven tools of SQC, the tools of TQM and Quality Systems.
3. Determine the hindrances for implementation of TQM principles, application of seven tools of SQC and the tools of TQM
4. Differentiate the costs of quality and outline the processes of development of a TQM organization

MODULE I
Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

MODULE II
TQM Principles - Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

MODULE III
Statistical quality control - The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

MODULE IV
TQM tools - Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs.
Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing

References:

1. Dale H.Besterfiled Inc. Total Quality Management, Pearson Education. 2003 (Indian reprint 2004).
2. James R.Evans & William M.Dale H.Besterfiled, Total Quality Management, Pearson Education.
3. Lidsay., The Management and Control of Quality, (5th Edition), South-Western (Thomson Learning). (2002).
4. Narayana V. and Sreenivasan, N.S. Quality Management – Concepts and Tasks, New Age International. 1996.
5. Zeiri, Total Quality Management for Engineers, Wood Head Publishers. 1991.

19-206-0803 HUMAN FACTORS ENGINEERING

Course Outcomes:

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

1. Interpret human information processing ability and the parameters influencing it.
2. Exemplify information receptors and visual and auditory displays.
3. Calculate physical work load, and energy consumption for various activities.
4. Design workspace and arrange components in work space.

Module I

Human factors - objectives and approach. Systems thinking - human –machine systems, characteristics of systems, system reliability. Human beings as information processors- information theory, displaying information, coding of information, characteristics of good coding system, compatibility, types of compatibility, perception, memory, decision making, attention, age and information processing, mental workload and its measurement.

Module II

Process of seeing, visual capabilities, accommodation, visual acuity, contrast sensitivity, factors affecting visual acuity and contrast sensitivity, adaptation, colour discrimination, perception. Design of hard copy and VDT screens. Graphic representations – symbols, objectives and criteria for selection, perceptual principles of symbolic design. Codes – dimension, colour.

Design of dynamic information displays, uses of dynamic information, design of quantitative visual displays, design of qualitative visual displays, design of signal and warning lights, recommendations regarding signal and warning lights, representational displays, head-up displays.

Hearing, nature and measurement of sound, complex sound, anatomy of ear, conversion of sound waves to sensations, masking. Auditory displays, detection of signals, relative discrimination and absolute identification of auditory signals, sound localization, principles of auditory display, cutaneous senses, tactual displays, substitutes for hearing and seeing, olfactory senses and displays.

Module III

Physical work - muscle physiology, work physiology, measures of physiological strain, physical work load, work efficiency, energy consumption, grades of work, factors affecting energy consumption, controlling energy expenditure, strength and endurance, measurement of strength, factors affecting strength. Manual materials handling – lifting tasks, carrying tasks, pushing tasks, limits of MMH tasks, reducing risks of MMH overexertion.

Motor skills – biomechanics of human motion, types of body movements, range of movements, classes of motor movements, Speed of movements – reaction time, movement time, accuracy of movements.

Human control of systems – compatibility, spatial compatibility, movement compatibility. Supervisory control. Controls devices – functions of control, factors in control design.

Principles of hand tool and device design.

Module IV

Workplace design – anthropometry, static dimensions, dynamic dimensions, principles in the application of anthropometric data. Work spaces - work-space envelopes for sitting and standing personnel, out-of-reach and clearance requirements. Design of work surfaces. Science of seating - general principles of seat design. VDT workstations.

Arrangement of components within a physical space – principles of arranging components, methodologies for arranging components, types and uses of various data, link diagrams, general location of various controls and displays within work space, specific arrangements of controls and displays within work space, spacing of control devices. General guidelines in designing individual workplaces.

References:

1. Sanders, M.M. and McCormick, E.J. Human factors in engineering & design, (Seventh edition). McGraw-Hill, New York. (1993).
2. Martin Helander. A guide to ergonomics of manufacturing. Tata McGraw Hill, New Delhi. (1996).
3. Bridger, R.S. Introduction to ergonomics. (Third edition). CRC Press. (2008).
4. Mark R. Lehto and James R. Buck. Introduction to human factors and ergonomics for engineers, Lawrence Erlbaum Associates, Taylor & Francis Group, New York.(2008).

19-206-0804 COMPUTATIONAL FLUID DYNAMICS

Course Outcomes:
On completion of this course, the student will be able to:
1. Identify the governing equations of fluid dynamics
2. Express derivatives and differential equations through discretization techniques
3. Understand the general transformation equations for grid generation.
4. Solve fluid flow field using some popular CFD techniques

Module I
Introduction - Impact and applications of CFD in diverse fields - Governing equations of Fluid dynamics – Continuity - Momentum and energy - Generic integral form for governing Equations - Initial and Boundary conditions - Governing equations for boundry layers - Classification of partial differential equations – Hyperbolic - Parabolic - Elliptic and Mixed Types - Applications and relevance.

Module II
Basic aspects of discretization - Discretization techniques – Finite difference – Finite Volume and Finite Element Method– Comparison of discretization by the three methods - Introduction to Finite differences - Transient one-dimensional and two-dimensional Conduction – Explicit - Implicit - Crank-Nicolson - ADI scheme – Stability criterion.
Difference equations - Numerical errors - Grid independence test - Optimum step size.

Module III
Grid generation – General transformation of the equations - Form of the governing Equations suitable for CFD – Boundary fitted co-ordinate systems – Elliptic grid generation - Adaptive grids - Modern developments in grid generation.

Module IV
Steady one-dimensional convection and diffusion - Central difference, upwind, quick, Exponential, false diffusion, hybrid and power law schemes. Transient one dimensional heat conduction equation.
Representation of the pressure - Gradient term and continuity equation – Staggered grid - Momentum equations - Pressure and velocity corrections - Pressure Correction equation - Numerical procedure for SIMPLE algorithm - Boundary conditions for the pressure correction method. Stream function – Vorticity method - Discussion of case studies.

References:
1. Versteeg H., Malalasekera W. An Introduction to Computational Fluid Dynamics: The Finite Volume Method (2nd Edition), Prentice Hall. (2007)
2. Anderson .J.D. Jr. Computational Fluid Dynamics – The basics with applications, McGraw-Hill, ISE. (2000).
3. Muralidhar K., Sundarajan T., Computatioanl Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi. (2001).
4. Patankar S.V. Numerical Heat Transfer and Fluid Flow, Hemisphere,New York. (1999).
5. Ranade V.V Computational Flow Modeling for Chemical Reactor Engineering, Academic Press. (2002).

19-206-0805 INTELLECTUAL PROPERTY RIGHTS

Course Outcomes:

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

1. Recall important international Conventions on intellectual properties and understand their implications on IP laws
2. Describe the provisions of laws on patent, copyright, trademarks, designs, confidential information and semiconductor IC layout-design
3. Explain the legal provisions with case laws
4. Analyse the provisions and the rationale behind decisions in important cases and apply law to fictitious cases

Module I

Concept of property vis-a-vis intellectual property – Overview of important international Conventions – Paris Convention 1883 – Berne Convention 1886 – WIPO – WIPO Copyright Treaty 1996 – Hague Agreement 1925 – TRIPS Agreement – WTO.

Module II

Patents Act 1970 – invention – inventive step – new invention – product patent – process patent – general conditions for conferring patent right – inventions not patentable – pipeline protection – procedure for obtaining patent – provisional and complete specification – priority dates – publication and examination – search for anticipation by previous publication and prior claim – Controller and his powers – opposition – grant of patents – term of patent – patents of addition – register of patents – lapse and restoration of patents – compulsory licence – revocation of patents – rights of patentee – infringement of patent right – remedies – Patent agent.

Module III

Copyright Act 1957 – meaning – general principles – author of copy right – registration of copyright – term of copyright – Performer's right – Assignment and licence – compulsory licence – infringement of copyright – remedies – moral right. Copyright establishments.

Module IV

Trade Marks Act 1999 – meaning – registration – duration – collective mark – certification trade mark – infringement and remedies – assignment and transmission of trademarks – passing off. Design Act 2000 – meaning – author and proprietor of design – registration – copyright in registered designs – cancellation of registration – piracy. Confidential information. Semiconductor Integrated Circuits Layout-design Act 2000 – definitions – prohibions of registration of certain layout designs – registration – opposition of registration – effect of registration – infringement – assignment and transmission – appeal.

References:

1. Intellectual Property Laws Bare Acts, Universal Law Publishing Co. (2014).
2. Gopalakrishnan, N. S. and Agitha, T. G. Principles of Intellectual Property (2nd ed.). Eastern Book Co. (2014).
3. Deborah, E. Bouchoux Intellectual Property: Trademarks, copyrights, patents and trade secrets (3rd ed.) Cengage. (2012).

19-206-0806 ADVANCED SAFETY ENGINEERING AND MANAGEMENT

Course Outcomes:

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

1. Describe various methods to improve the safety and reliability of safety systems
2. Solve simple problems related to layer of protection analysis (LOPA) by adding additional independent protection layers (IPL).
3. Explain the concept of behaviour-based-safety and its implementation
4. Interpret the various threats and vulnerability in process industries in order to devise strategies to counter attacks.

Module I

Domino incident investigation – technique, logic diagram, input requirements, output, example. Unavailability analysis of protective systems – technique, logic diagram, input requirements, example.Reliability analysis of automatic control systems - PES safety system development logic diagram system analysis, calculation of fractional dead time, application, strengths and weaknesses.Introduction to MORT analysis,Sneak analysis.

Module II

Layer of Protection Analysis (LOPA) – Overview of relevant standards and guidelines, risk tolerance criteria. Preparation of LOPA – LOPA methodology, the LOPA team. Scenario development – components, inherently safe considerations. Initiating causes / effects – identification, estimation of frequencies. Independent protection layers – IPL criteria, allocation of IPL credit – basic process control systems, operator response, pressure relief device, safety instrumented system, safety instrumented function. Safety integrity level (SIL) assignment, Interpreting LOPA results, risk decisions and making recommendations.

Module III

Security for chemical process industries - Assessments and regulatory environment, methods for assessing security vulnerability, emerging security regulations, government development and industry activities that relate to security for process facilities. Strategies and counter measures – prevention of intentional releases and theft of chemical releases at process facilities.

Site security for process industries – Essential elements – threat analysis, security counter measures, mitigation and emergency response. Specific security measures – information security, cyber security, physical security, policies and procedures, training, mitigation and response, inherently safer processes. Case study.

Module IV

Behaviour- Based Safety (BBS) - Fundamentals of BBS, Observation and feedback process – people based safety, BBS experience, Checklist for critical behaviour, Outocmes of BBS work, Implementation problems in BBS, Praxis six cell analysis model. Behaviorual safety Observation Process. Mangers role in developing BBS culture. BBS steering committee. Main steps of True BBS approach.

Safety Management Systems: SHEMS, OHSAS 18001 and OSHA's PSM – Policy, planning, training, implementation, management control and review.

References:

1. Centre for Chemical Process Safety. AIChE: Guidelines for Chemical Process Quantitative Risk Analysis, Second edition. (2000).

2. Centre for Chemical Process Safety, AIChE: Layer of Protection Analysis – Simplified Process Risk Assessment. (2001).

3. ACC: Site Security Guidelines for the U.S Chemical Industry American Chemistry Council, Washington DC. (2001).
4. Sam Mannan (Editor). Lee's Loss Prevention in the Process Industries. (Fourth edition). Butterworth-Heinemann Ltd., UK. (2012).
5. Thomas R. Krause. The Behaviour – based safety process: Managing involvement for an injury-Free Culture. (Second edition). John Wiley & Sons. (1996).
6. Kaila, H.L. Behaviour based safety in organisations – a practical guide. IK International, New Delhi. (2010).

19-206-0807 FLUID POWER SAFETY

Course Outcomes:

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

1. Define the laws pertaining to hydraulics & pneumatics and describe the elements of hydraulic & pneumatic systems.
2. Classify the different components of hydraulic & pneumatic systems: pumps, compressors, control values and actuators.
3. Determine the different components required for a specified hydraulic & pneumatic application.
4. Draw circuits to illustrate the function of various components of hydraulic & pneumatic systems and outline simple circuits for specific applications.

Module I

Introduction to Hydraulics- Pascal's Law- Conservation of energy- Pressure, Work and Power- Principles of Power Hydraulics, Pressure and Flow Measurements- Bernoulli's Principle- Hydraulic symbols- Advantages. Hydraulic fluids, Properties Piping and Seals- Reservoirs. Actuators-Cylinders, Rams, Hydraulic Motors. Pumps- Gear, Vane and Piston types- Fixed and variable flow. Testing of Actuators & Pumps- Safety Precautions

Module II

Directional Control- Check valve, Pilot – operated, Two- way and Four -way valves- Rotary valves. Pressure Control – Relief valves- Different functions. Volume control- Methods and Types. Testing of Control Valves and Safety precautions.

Module III

Pneumatic Systems: Introduction: Production of compressed air, Air Receives, Accumulators, Dry and oil free compressed air.

Pneumatic control: Components, Types of Cylinders, Control Valves- Direction, Pressure and Flow, Air Motors and Pneumatic Symbols.

Maintenance & Safety: Compressors & Accessories.

Module IV

Accessories- Accumulators, Pressure Switches. Fluid Power Systems, Simple circuits- Hydraulic, Pneumatic, Hydro pneumatic and Electrohydraulic. System Maintenance and Safety.

References:

1. Majumdar.S.R. Oil hydraulic Systems– Principles & Maintenance,(28th edition) Mcgraw Hill Education. .(2017)
2. Majumdar. S. R. Pneumatic Systems – Principles & Maintenance, (1st edition)Mcgraw Hill Education. .(2017)
3. Esposito, Anthony. Fluid Power with applications,(7th edition) Pearson Education Asia. (2008)
4. Jagadish Lal. Hydraulic Machines, Metropoliton Books (1994).
5. J.Pippenger & T. Hicks. Industrial Hydraulics. McGraw Hill.(1980).

19-206-0808 EXPLOSIVES TECHNOLOGY AND SAFETY

Course Outcomes:
On completion of this course the student will be able to:
1. Explain the chemistry of explosives and the mechanisms of burning
2. Describe the concepts of shock, detonation and initiation
3. Interpret scaling in design and analysis of explosive devices
4. Summarize the importance of safety in explosives operations, storage and transportation

Module I
Chemistry of Explosives – Chemical reactions – Categories of explosives by chemical type – Use forms of Explosives, Propellants, and Pyrotechnics.
Mechanics of Burning – Burning model – Geometry shape of grains – Calculating the state of the gas – interior ballistics.

Module II
Sound, shock and Detonation – Sound waves – shock waves – Detonation waves – Explosive output tests.
Initiation and initiators – Initiation theory and criteria – Initiation sensitivity testing – Non electric initiators – Hot-wire initiators – exploding bridge wire detonators – Slapper detonators.

Module III
Scaling in Design and Analysis – Geometric similarity – Accelerating metal with explosives – Shock waves in air – Shock waves in water – Craters from explosives – Conical – shaped chargers.
Off-the - Shelf explosive Devices – Linear explosive products – Mechanical / explosive devices.

Module IV
Classification, Transportation and Storage of Explosives – Explosives classification – Transportation of explosives – Storage of explosives.
Explosive Facilities and Explosives Operations – Explosive facilities – Explosive operations – Good work practices – Maintenance – Explosive waste – Spills and general cleaning – Explosive handling – Testing and firing of explosives – Licenses, permits and penalties.

Reference:
1. Paul Cooper and Stanley R. Kurowski. Introduction to the Technology of Explosives. Wiley – VCH, New York. (1996).

19-206-0809 INTRODUCTORY DESIGN OF STRUCTURES

Course Outcomes:
On completion of this course the students will be able to:

1. Interpret the concepts of RC design and design RC flexural members
2. Design RC columns
3. Explain the concepts of steel structural design and design different types of joints in steel structures
4. Design structural steel tension and compression members and beams

Module I
Concrete structures: Structural forms – loads – serviceability, strength and structural safety – design basis – design codes. Material properties: Properties in compression – tensile strength – reinforcing steels for concrete.
Flexural design of R.C. beams: Bending of homogeneous beams – reinforced concrete beam behaviour – design for tension reinforcement in rectangular reinforced concrete beam – introduction to design aids – rectangular beams with tension and compression reinforcement.

Module II
Edge supported R.C. Slabs: Types of slabs – design of one-way slabs – temperature and shrinkage reinforcement. R.C. Columns: Design of short columns – axial compression – lateral ties and spirals – compression plus bending in rectangular columns – Code provisions for design of short columns.

Module III
Structural steel materials and specifications: Rolled steel sections- types of structural steel – specifications
Structural Fasteners: Types of riveted and bolted joints –strength of a riveted joint –design of riveted joints for axially loaded members – welded joints – advantages and disadvantages of welded joints – types of welds and their symbols –design of fillet weld – design of butt weld – design of plug and slot weld. Design of bolted joint

Module IV
Structural steel tension member: Net sectional area – permissible stresses – design of axially loaded tension member – lug angle – tension splice. Compression member: Strength of an axially loaded compression member – effective length – maximum slenderness ratio. Beams: Design procedure for laterally supported and unsupported beams – built up beams – plate thickness – simple beam end connectors.

References:

1. Nilson, A. H. Design of Concrete Structures (14th ed.). McGraw Hill Companies Inc. (2009).
2. Pillai, S. U. & Menon, D. Reinforced Concrete Design (3rd ed.). Tata McGraw Hill, New Delhi. (2009).
3. Varghese, P. C. Limit State Design of Reinforced Concrete (2nd ed.). Prentice Hall India, New Delhi. (2002).
4. Bhavikatti, S. S. Design of Steel Structures (3rd ed.). I. K. International Publishing House. (2012).
5. Ramamrutham, S. Design of Steel Structures. Dhanpat Rai Publications. (2004).
6. Dayaratnam Design of Steel Structures. S. Chand, (1996).

19-206-0810 HISTORY AND PHILOSOPHY OF SCIENCE

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

1. Summarize the central questions and debates facing philosophers of science today,
2. Compare and contrast the predominant philosophical positions on such questions and debates,
3. Explain the importance of such issues by appeal to specific episodes from the history of scientific thought,
4. Exercise an improved ability to think philosophically about today's scientific research and findings.

Module I
The Inductive Method of Francis Bacon - The "Corpuscular" Philosophy(Robert Boyle - The New Star (Tycho Brahe) - The Motion of the Earth (Nicholas Copernicus) - Tradition and Experience (Galileo Galilei) - The Copernican View Vindicated - A Man Ahead of His Time - Johannes Kepler - On Arguments About a Moving Earth (Johannes Kepler). The Explanatory Scope of the Evolutionary Hypothesis (Charles Darwin) - Rationalism and Scientific Method (René Descartes) - Rules for the Discovery of Scientific Truth (René Descartes).

Module II
Catastrophist Geology (Georges Cuvier) - Successful Hypotheses and High Probability (Christiaan Huygens) - Determinism, Ignorance, and Probability (Pierre-Simon Laplace) - The Nature of Scientific Explanation (Antoine Lavoisier) - Space, Time, and Symmetry (Gottfried Wilhelm Leibniz) - The Principle of Least Action (Gottfried Wilhelm Leibniz) - Inductive Methodology (Isaac Newton). Space, Time, and the Elements of Physics (Isaac Newton) - On the Method of Theoretical Physics (Albert Einstein).

Module III
Against Crucial Experiments (Pierre Duhem) - On Observation (N. R. Hanson) - Scientific Explanation(Carl Hempel) - Hypotheses, Data, and Crucial Experiments (John Herschel) - The Nature of Cause and Effect (David Hume) - Human Knowledge: Its Scope and Limits (John Locke) - The Role of Hypotheses in Physical Theor (Henri Poincaré) - Dissolving the Problem of Induction (Peter Strawson) - Against Pure Empiricism (William Whewell) – Science and Non-Science: The Demarcation Problem (Popper, Kuhn, Lakatos, Thagard, Ruse, Laudan).

Module IV
The nature of science and technology in India, Roots of science and technology in India, Science and society, Scientists and society, Science and Faith and the rise of applied sciences.
Science and Technological Developments in Major Areas in India -
Space – Objectives of space programs, Geostationary Satellite Services – INSAT system and INSAT services remote sensing applications, Launch Vehicle Technology
Ocean Development – Objectives of ocean development, Biological and mineral resources, Marine research and capacity building. Defence Research – Spin-off technologies for civilian use
Biotechnology – Applications of biotechnology in medicine, Biocatalysts, Agriculture, Food, Fuel and Fodder, Development of biosensors and animal husbandry.
Energy – Research and development in conservation of energy, India's nuclear energy program, technology spin-offs.

References:

1. Timothy McGrew, Marc Alspector-Kelly, and Fritz Allhoff (eds.) Philosophy of Science: An Historical Anthology, Wiley - Blackwell. (2009).
2. Thomas S. Kuhn The Structure of Scientific Revolutions, 3rd ed. University of Chicago Press, Chicago. (1996).
3. Menon R.V.G. An Introduction to the History and Philosophy of Science, Pearson. (2010),
4. Menon R.V.G. Technology and Society, Pearson. (2011).

19-206-0811 NON-DESTRUCTIVE TESTING METHODS

Course Outcomes:
On completion of this course the student will be able to:
1. Classify various non destructive testing methods.
2. Monitor different metals and alloys by visual inspection method.
3. Explain non-destructive tests like: Liquid penetrant test, Magnetic particle test, Ultrasonic test, X-ray and Gamma ray radiography, Leak Test, and Eddy current test.
4. Detect defects by using relevant NDT methods.

Module I
Introduction: Fundamentals of and introduction to destructive and non-destructive testing. Scope and limitations of NDT, Visual examination methods, Different visual examination aids.
Dye penetrant Testing/ liquid penetrant testing: Principle, procedure, characteristics of penetrant, types of penetrants, penetrant testing materials,fluorescent penetrant testing method– sensitivity, application and limitations

Module II
Magnetic Particle Testing: Important terminologies related to magnetic properties of material, principle, magnetizing technique, procedure, equipment, fluorescent magnetic particle testing method, sensitivity, application and limitations. **Ultrasonic Testing**: Basic principles of sound propagation, types of sound waves, Principle of UT, methods of UT, their advantages and limitations, Piezoelectric Material, Various types of transducers/probe, Calibration methods, use of standard blocks, technique for normal beam inspection, flaw characterization technique, defects in welded products by UT, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, advantage, limitations acoustic emission testing – principles of AET and techniques

Module III
Radiographic testing: X-ray and Gamma-Ray radiography, Their principles, methods of generation, Industrial radiography techniques, inspection techniques, applications, limitations, Types of films, screens and penetrameters. Interpretation of radiographs, Safety in industrial radiography.

Module IV
Leak and pressure testing: Definition of leak and types, Principle, Various methods of pressure and leak testing, Application and limitation
Eddy current testing: Principle, instrument, techniques, sensitivity, application, limitation.
Thermal methods of NDT**.**

References:

1. Baldev Raj, T. Jayakumar & M. Thavasimuthu. Practical Non-destructive Testing, Norosa Publishing House, New Delhi.
2. Dr. C.G. Krishnadas Nair (Ed). Treaties on Non-destructive testing, Vol. 1, 2 & 3 Edited by, NDT Centre, HAL, Bangalore
3. Warren J. McGonnagle. Non-destructive testing, Gordon Breach Science Publishers Ltd.
4. Krautkramer J. and Herbert Krautkramer. Ultrasonic Testing of Materials, Narosa Publishing House, New Delhi.
5. Hatmshaw R, Non-destructive testing, Leszek Filipezynski, Zdzislaw Pawlowski & Jerzywehr. Ultrasonic Methods of Testing Materials, , Butterworths, London

19-206-0812 ENVIRONMENTAL ECONOMICS

Course Outcomes:

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

1. Explain the concepts of willingness to pay, public goods, property rights, market and nonmarket valuation techniques
2. Summarize the economics of pollution prevention.
3. Exemplify the economic instruments for environment protection
4. Interpret the optimal use of exhaustible resources

Module I

Introduction to Economics: Principles of Economics – Economics, Ecology and Ethics - Wealth, Welfare, Scarcity, Growth and Sustainability definitions -– Concepts of Costs, Benefits, Opportunity costs , Social Costs –Marginal Costs and Marginal Benefits - Positive and Normative criteria for decision making - Consumer Choice theory –Supply and Demand– Economic Efficiency and Markets–Static and dynamic efficiency - market failures – property rights, externalities and environmental problems – Coase Theorem - Public Goods and Externalities - Free rider problem – Tragedy of the commons.

Module II

Valuation of Environmental costs and benefits : Types of Economic value - Environmental Benefits and Environmental Costs - Valuing the Environment – Direct and indirect methods – Surrogate markets – Stated Preference and Revealed Preference methods- hedonic prices, travel cost models, contingent valuation, benefit transfer – economic valuation of ecosystem services- Assessment of Loss of Ecology - Valuation of Health impacts - Environmental accounting. Economics of pollution prevention: Economics of Environmental Quality- - Cost benefit analysis and Cost effectiveness analysis – Principles, methodology and Limitations – Discounting - Profitability of Pollution Prevention - Payback period – Present value estimation – Internal rate of return – Opportunity costs – Economic analysis of Pollution Prevention. Case studies.

Module III

Economic instruments for environmental protection: Point vs. Nonpoint Sources - Stock vs. Fund Pollutants - Nature of Marginal abatement cost and that of Marginal damage cost -Efficient level of pollution, total cost of efficient level of pollution - Polluter pays Principle –Economic Optimum level of Pollution- Marginal Damage Functions – Marginal Abatement Costs - Allocation of Stock and Fund Pollutants - Economic analysis of Environmental Policy - Regulatory versus Economic Instruments – Decentralized Policies: Liability Laws, Property Rights,and Moral Suasion - Command-and-Control Strategies - Pigovian and Pollution Taxes – Incentive-Based Strategies: Emission Charges and Subsidies– Marketable permits – Emission trading -– Non Compliance fees, bonds and deposit refunds –Evaluation of Instruments – Choice of instruments for Environmental policy.

Module IV

Natural resource economics: Types, scarcity and classification of Natural Resources – Depletable and non renewable resources – Recyclable resources – Replenishable but depletable resources – Storable renewable resources – Renewable common property Resources– Economic Theory of Depletable Resources- Optimal Use of Exhaustible Resources- – Natural resources accounting - Economics of Forestry and fisheries exploitation –Trade and environment – Income

Effects and Environmental Kuznets Curves – Race to the Bottom and Pollution Haven Hypothesis - Porter Hypothesis - Economics of Climate Change.

References:

1. Barry Field and Martha Field, Environmental Economics: An Introduction, McGraw-Hill
2. Kolstad, Charles. Environmental Economics, Oxford University Press, New York. (2011).
3. John Asafu Adjaye, Environmental Economics for non-Economists – techniques and policies for Sustainable Development, World Scientific. (2005).
4. Tom Tietenberg, Environmental and Natural Resource Economics, 5th Edition, Harper Collins College Publishers. (2000).
5. Nick Hanley, Jaison F. Shogren and Ben White Environmental Economics – In theory and practice Macmillan India Ltd, New Delhi. (1999).
6. Perman R, Y. Ma, J. McGilvray and M. Common Natural Resource and Environmental Economics, 3rd edition, Pearson Education, Harlow. (2003).

19-206-0813 BIOLOGY FOR ENGINEERS

Course Outcomes:

On completion of this course the student will be able to

1. Correlate basic biological and engineering principles in the organizational structure of living systems at molecular, cellular and system level
2. Appreciate the applications of energy transformations in biological systems in view of solving energy conservation targets
3. Analyse information processing in biological systems
4. Apply the modern developments in biology and engineering for society, human health and environmental sustainability

Module I

Biomolecules and biopolymers: Structure and Function Organic and inorganic molecules; Unique Properties of water, Vitamins and Minerals, Carbohydrates, Lipids, Amino Acids and proteins, Nucleic Acids (DNA and RNA). Levels of organization of life: Cell as a basic unit of life, prokaryotic and eukaryotic cells, microbes, plant and animal cells; Cell organelles – structure and function; Cell membrane Levels of organization: cells, tissues, organs, systems & organism

Module II

Energy transformations in Chloroplast: Photosynthesis (photochemical & biochemical phase) and ATP generation, Aerobic and anaerobic systems Energy transformations in Mitochondria: Cellular respiration (glycolysis and Kreb cycle) and ATP generation Bioenergetics: Thermodynamic principles applied to biology, negative entropy changes in biological systems, Free Energy, Chemical Equilibrium.

Module III

Expression and Transmission of Genetic Information: DNA replication, Enzyme driven process of DNA cloning, Protein synthesis- Transcription & translation Techniques for optimization: a. At molecular level: Recombinant DNA Technology, DNA hybridization, PCR, DNA microarray

Module IV

Engineering perspectives of biological sciences: Biology and engineering crosstalk – At cell level: Hybridoma technology At tissue level: Plant Tissue Culture, Animal Tissue Culture; Tissue Engineering: Principles, methods and applications Introduction to Biomimetics and Biomimicry, Nano biotechnology

References:

1. G. K. Suraishkumar. Biology for Engineers. Oxford University Press. 2019.
2. Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Biology: A global approach. Tenth Edition. Pearson Education Ltd. 2015.
3. Nelson, D. L.; and Cox, M. M. Lehinger Principles of Biochemistry. Seventh Edition.W.H. Freeman and Company, 2017.
4. Peter Paolella. Introduction to Molecular Biology. McGraw Hill Education, 2010.

19-200-0814 CONSTITUTIONAL LAW

Course Outcomes:

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

1. Configure the preamble and fundamental rights.
2. Actuate the governance and functioning of constitutional functionaries.
3. Describe the functions of legislative bodies.
4. Decipher the judiciary system and its role in governance.

Module I: Introduction

Constitution Law – Constitutional Assembly Debates – Constitution of India – Basic Features of Indian Constitution – Preamble – Structure and Content of Indian Constitution

Module II: Fundamental Rights

Rights – Fundamental Rights – Definition of State – Fundamental Rights under Indian Constitution – Right to Equality – Untouchability – Title – Right to Life Cultural and Educational Rights of Minorities - Enforcement of Fundamental Rights

Module III: Directive Principles of State Policy & Fundamental Duties

DPSP's – Relationship between DPSP and Fundamental Rights – Conversion of DPSP into Fundamental Rights – Role of Judiciary – Judicial Activism – PIL - Fundamental Duties

Module IV: Constitutional Organs

Legislative Organs – Parliament – Lok Sabha, Rajya Sabha - State Legislatures - Executive Organs - President, Vice President, Council of Ministers - Judicial Organs – Supreme Court and High Courts – Other Constitutional Bodies – Election Commission - Comptroller and Auditor General of India, etc.

References:

1. Durga Das Basu, Introduction to the Constitution of India, 24th Edition. Prentice – Hall of India Pvt. Ltd. New Delhi, 2019.
2. D.C. Gupta, Indian Government and Politics, 8th Edition. Vikas Publishing House, 2018.
3. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes. Universal Law Publication, 2015.

19-206-0815 SEMINAR

Course Outcomes:

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

1. Classify good publications and journals in their field of study.
2. Produce independent reports, name them based on a central theme and write abstracts, main body, conclusions and reference identifying their intended meaning and style.
3. Summarize the various tools of presentation
4. Recognize time management, leadership quality and rapport with an audience.

Students shall individually prepare and submit a seminar report on a topic of current relevance related to the field of Safety and Fire Engineering and allied fields. The reference shall include standard journals, conference proceedings, reputed magazines textbooks and technical reports. The references shall be incorporated in the report following International standards reflecting the state-of-the-art in the topic selected. Each student shall present a seminar for about 30 minutes duration on the selected topic. The assessment shall be based on style of presentation, technical content, adequacy of references, depth of knowledge and overall quality of the seminar report.

19-206-0816 PROJECT PHASE II

Course Outcomes:

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

1. Exemplify various steps involved in conducting a project work, like literature survey, methodology adopted – field study / survey / experiments / numerical work, analysis of the data to arrive at final results and conclusions, etc.
2. Produce reports in proper style of writing with all the major components
3. Explain the pros and cons of working in a team and the wonderful results which could evolve through team-work.
4. Explain a self-prepared and corrected report (with the help of project guide) of a self-created work to a peer audience.

Each batch of students shall design and develop the project. The implementation phase shall proceed as follows:

- A detailed project report in the prescribed format shall be submitted at the end of the semester. All test results and relevant design and engineering documentation shall be included in the report.
- The work shall be reviewed and evaluated periodically
  A committee consisting of the Project Coordinator (appointed by the Head of the Department / Division), project guide and at least one senior faculty member shall carry out the assessment.
- At least one interim review and a final review just before the submission of the project report shall be carried out to assess the work done by students.

Final evaluation of the project shall include the following:

- Presentation of the work by each student in a group
- Oral examination
- Demonstration of the project against design specifications
- Quality and content of the project report.

Guidelines for evaluation:		*Marks*
1.	Regularity and progress of work	20
2.	Work knowledge and Involvement	50
3.	End semester presentation and oral examination	50
4.	Level of completion & demonstration of Functionality / Specifications	50
5.	Project Report – Presentation style and content	30
	Total	**200**

Note: Points 1 and 2 to be evaluated by the respective project guide and the project coordinator based on continuous evaluation. 3-5 to be evaluated by the final evaluation team.

19-206-0817 COMPREHENSIVE VIVA VOCE

Each student is required to appear for a comprehensive viva-voce examination before a panel of examiners at the end of the completion of the course work. The examiners shall evaluate the students in terms of their conceptual grasp of the subject learnt during the entire course of study and practical/analysis skills etc.