Appendix - VII

B.TECH DEGREE COURSE IN SAFETY & FIRE ENGINEERING

(2015 Admissions)

SCHEME OF EXAMINATIONS AND SYLLABUS

III to VIII SEMESTERS

B.TECH DEGREE COURSE IN SAFETY & FIRE ENGINEERING

Scheme of Examinations (2015 admissions)

SEMESTER I [Stream A]

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs / Wk	C	Marks		Total
						CA	ESE	
AS15-1101A	Calculus	3	1	0	3	40	60	100
AS15-1102A	Engineering Physics	3	1	0	3	40	60	100
GE15-1103A	Engineering Mechanics	4	1	0	4	40	60	100
GE15-1104A	Basic Civil Engineering	3	0	0	3	40	60	100
GE15-1105A	Basic Mechanical Engineering	3	0	0	3	40	60	100
HS15-1106A	Technical Communication and Professional Ethics	2	1	0	2	40	60	100
GE15-11L1A	Civil Engineering Workshop	0	0	3	1	25	25	50
GE15-11 L2A	Mechanical Engineering Workshop	0	0	3	1	25	25	50
HS15-11L3A	Language Lab	0	0	1	1	25	25	50
HS15-11L4A	NSS/Nature conservation	0	0	1	1	50	-	50
	TOTAL	**18**	**4**	**8**	**22**			

CA – Continuous Assessment, ESE – End Semester Examination

SEMESTER II [Stream A]

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs / Wk	C	Marks		Total
						CA	ESE	
GE15-1201A	Computer Programming	3	1	0	3	40	60	100
AS15-1202A	Engineering Chemistry	3	1	0	3	40	60	100
GE15-1203A	Engineering Graphics	2	1	3	5	40	60	100
GE15-1204A	Basic Electrical Engineering	3	0	0	3	40	60	100
GE15-1205A	Basic Electronics Engineering	3	0	0	3	40	60	100
AS15-1206A	Environmental Studies	3	1	0	3	40	60	100
GE15-12L1A	Electrical Engineering Workshop	0	0	3	1	25	25	50
GE15-12L2A	Computer Programming Laboratory	0	0	3	1	25	25	50
	TOTAL	**17**	**4**	**9**	**22**			

SEMESTER III

Code No.	Subject	L Hrs/ Wk	T Hrs/ Wk	P Hrs/ Wk	C	CA	ESE	Total
AS15 -1301	Linear Algebra & Transform Techniques	3	1	0	3	40	60	100
SE15 -1302	Chemical Process Principles	3	1	0	3	40	60	100
SE15- 1303	Engineering Fluid Mechanics and Machinery	3	1	0	3	40	60	100
SE15 -1304	Principles of Safety Management	3	1	0	3	40	60	100
SE15 -1305	Elements of Machine Drawing	1	0	3	3	40	60	100
SE15- 1306	Safety in Construction	3	1	0	3	40	60	100
SE15- 13 L1	Fluid Mechanics & Machinery Laboratory	0	0	3	2	25	25	50
SE15 – 13 L2	Safety Engineering Laboratory	0	0	3	2	25	25	50
	TOTAL	**16**	**5**	**9**	**22**			

SEMESTER IV

Code No.	Subject	L Hrs/ Wk	T Hrs/ Wk	P Hrs/ Wk	C	CA	ESE	Total
AS15 - 1401	Complex Variables and Partial Differential Equations	3	1	0	3	40	60	100
SE15 - 1402	Heat and Mass Transfer Operations	3	1	0	3	40	60	100
SE15 - 1403	Strength of Materials	3	1	0	3	40	60	100
SE15 -1404	Fire Engineering Fundamentals	3	1	0	3	40	60	100
SE15 -1405	Electrical Technology and Safety	3	1	0	3	40	60	100
SE15 - 1406	Occupational Health and First Aid	3	1	0	3	40	60	100
SE15 – 14 L1	Strength of Materials Laboratory	0	0	3	2	25	25	50
SE15 – 14 L2	Electrical Technology Laboratory	0	0	3	2	25	25	50
	TOTAL	**18**	**6**	**6**	**22**			

SEMESTER V

Code No.	Subject	L Hrs/ Wk	T Hrs/ Wk	P Hrs/ Wk	C	CA	ESE	Total
AS15 - 1501	Numerical and Statistical Methods	3	1	0	3	40	60	100
SE15 - 1502	Chemical Technology and Reaction Engineering	3	1	0	3	40	60	100
SE15 - 1503	Principles of Engineering Design	3	1	0	3	40	60	100
SE15 - 1504	Planning and Design of Fire Protection Systems	3	1	0	3	40	60	100
SE15 - 1505	Manufacturing Processes	3	1	0	3	40	60	100
SE15 - 1506	Chemical Process Safety	3	1	0	3	40	60	100
SE15 – 15 L1	Chemical Engineering Laboratory	0	0	3	2	25	25	50
SE15 – 15 L2	Fire Safety Training	0	0	3	2	25	25	50
	TOTAL	**18**	**6**	**6**	**22**			

SEMESTER VI

Code No.	Subject	L Hrs/ Wk	T Hrs/ Wk	P Hrs/ Wk	C	CA	ESE	Total
SE 15 - 1601	Legal Aspects of HSE	3	1	0	3	40	60	100
SE 15 - 1602	Process Instrumentation and Control	3	1	0	3	40	60	100
SE 15 - 1603	Hazard Control in Manufacturing	3	1	0	3	40	60	100
SE 15 - 1604	Structural Fire Safety	3	1	0	3	40	60	100
SE 15 - 1605	Environmental Engineering and Management	3	1	0	3	40	60	100
SE 15 - 1606 E	Elective I	3	1	0	3	40	60	100
SE 15 – 16 L1	Machine Shop	0	0	3	2	25	25	50
SE 15 – 16 L2	Environmental Engineering & Management Laboratory	0	0	3	2	25	25	50
	TOTAL	**18**	**6**	**6**	**22**			

Elective I

E1 Power Plant Engineering
E2 Safety in Petroleum and Petrochemical Industries
E3 Food and Biosafety
E4 Fault Detection and Diagnosis
E5 Fire Dynamics

SEMESTER VII

Code No.	Subject	L Hrs/ Wk	T Hrs/ Wk	P Hrs/ Wk	C	CA	ESE	Total
SE 15 - 1701	Hazard Identification and Risk Assessment	3	1	0	3	40	60	100
SE 15 - 1702	Transportation Systems and Safety	3	1	0	3	40	60	100
SE 15 - 1703	Principles of Industrial Management	3	1	0	3	40	60	100
SE 15 - 1704	Life Safety in Building Fire	3	1	0	3	40	60	100
SE 15 - 1705 E	Elective II	3	1	0	3	40	60	100
SE 15 – 17 L1	Fire Engineering Laboratory	0	0	3	2	25	25	50
SE 15 – 17 L2	Industrial Hygiene Laboratory	0	0	3	2	25	25	50
GE 15 – 17L3	Entrepreneurship Development	0	0	2	1	50	-	50
SE 15 – 17 L4	Computational Laboratory	0	0	2	2	25	25	50
	TOTAL	**15**	**5**	**10**	**22**			

Industrial Internship for a minimum duration of two weeks during May- June vacation before the commencement of 7th Semester classes is desirable.

Elective II

E1 Reliability Engineering
E2 Automobile Engineering and Safety
E3 Industrial Ecology
E4 Fluid Power Systems
E5 Explosives Technology and Safety

SEMESTER VIII

Code No.	Subject	L Hrs/ Wk	T Hrs/ Wk	P Hrs/ Wk	C	CA	ESE	Total
SE 15 - 1801	Human Factors Engineering	3	1	0	3	40	60	100
SE 15 - 1802	Advanced Safety Engineering and Management	3	1	0	3	40	60	100
SE 15 - 1803	Disaster Management	3	1	0	3	40	60	100
SE 15 - 1804 E	Elective III	3	1	0	3	40	60	100
SE15 – 18L1	Seminar	0	0	3	2	50	-	50
SE 15 – 18 L1	Project	0	0	11	6	200	-	200
SE 15 – 18 L2	Comprehensive Viva Voce	0	0	0	2	-	50	50
	TOTAL	**12**	**4**	**14**	**22**			

Elective III

E1 Total Quality Management
E2 Introductory Design of Structures
E3 Computational Fluid Dynamics
E4 Intellectual Property Rights
E5 Statistical Methods for Engineers

LIST OF OPTIONAL SUBJECTS

Sl. No:	Subject	L	T	P	No: of Hours/Semester	CA Marks
1	Personality Enrichment	1	2		30	50
2	General Aptitude	1	2		30	50
3	Foreign Language	1	2		30	50
4	Advanced Computer Programming	1		2	30	50
5	Healthy Living	1		2	30	50
6	Theatre Arts	1		2	30	50
7	Imaging Devices	1		2	30	50
8	Disaster Management	1		2	30	50

One or more optional subjects may be offered in any semester outside regular teaching hours and the students may opt to study them if they wish. The course may be conducted by using experts from inside or outside the University on Self Supporting manner. The Fee may be fixed based on the expenses in a non-profit manner with the students of the department given a subsidised rate of fee and those from outside may also be allowed at a higher fee. The regular students may be issued the mark list with the optional subject included in current semester and the outsiders may be issued a certificate separately.

AS 15- 1301 LINEAR ALGEBRA & TRANSFORM TECHNIQUES
(Common for all branches)

Course Objectives:
To acquire fundamental knowledge in linear algebra and transform techniques and apply in engineering disciplines.

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. Understand 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. (2010). *Advanced engineering mathematics*. (tenth edition). John Wiley & Sons, Hoboken, N.J

2. Grewal, B.S. (2013). *Higher engineering mathematics*. (forty third edition). Khanna Publishers, New Delhi.
3. Hsiung,C.Y and Mao, G. Y. (1999). *Linear algebra*. World Scientific, New Jersey.
4. Hoffman, K. and Kunze, R. (1971). *Linear algebra*. Prentice Hall of India, New Delhi.
5. Venkataraman,M.K. (1999). *Linear algebra*. The National Publishing Co, Chennai.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15- 1302 CHEMICAL PROCESS PRINCIPLES

Course Objectives

To acquire knowledge about the basic principles of chemical process calculations, and basic laws, concepts and application of Thermodynamics and to learn the basic principles and types of equipment used for mechanical operations like screening, size reduction, sedimentation and filtration.

Course Outcomes

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

1. Formulate and solve material balance on processes with recycle, bypass and purge (with and without reaction)
2. Formulate and solve energy balance on processes with and without reaction
3. Explain the properties of thermodynamic systems and understand the significance of the laws of thermodynamics.
4. Select the right type of equipment 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. (2004). *Unit operations of chemical engineering*. (seventh edition). McGraw-Hill Education, New York.
2. Bhatt, V.I. and Vora, S.M. (2004). *Stoichiometry*. (fourth edition). Tata McGraw Hill, New Delhi.
3. Narayanan, K.V. and Lakshmikutty, B. (2006). *Stoichiometry and process calculations*. Prentice-Hall of India Pvt. Ltd, New Delhi.
4. Narayanan, K.V. (2013). *A text book of chemical engineering thermodynamics*. Prentice Hall of India Pvt Ltd, New Delhi.
5. Badger, W.L. and Banchero, J.T. (1997). *Introduction to chemical engineering*. Tata McGraw Hill Education, New Delhi.
6. Christe J. Geankoplis. (1993). *Transport process and unit operations*, Prentice Hall India Pvt Ltd, New Delhi.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 - 1303 ENGINEERING FLUID MECHANICS AND MACHINERY

Course Objectives

To teach the concept of fluid and its types, governing equations of fluid flow and its applications, flow Measurement techniques and mode of fluid transport and fluid machinery.

Course Outcomes

On completion this course the student will be able to:

1. Analyse fluid flow behaviour under different operating conditions
2. Apply Bernoulli's equation to flow problems
3. Estimate pressure drop through various flow devices
4. Select turbines and pumps depending on the need

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 – venturi meter, orifice meter, pitot tube.

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 – Rotary pumps: working principle of gear and vane pumps.

References:

1. Kumar, K.L. (1995). *Engineering fluid Mechanics*. (seventh edition). Eurasia Publishing House (P) Ltd, New Delhi.
2. McCabe, W.L. Smith J.C. and Harriot, P. (2000). *Unit operations in chemical engineering*. (sixth edition). McGraw-Hill, New York.
3. Vasandani, V.P. (1992). *Hydraulic machines – theory and design*. Khanna Publishers, New Delhi.
4. Streeter, V.L. and Wylie, E.B. (1983). *Fluid mechanics*, McGraw Hill, New York.
5. Edward J. Shaughnessy Jr. Ira M. Katz. and James P. Schaffer. (2005). *Introduction to fluid mechanics*. Oxford University Press, New Delhi.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 - 1304 PRINCIPLES OF SAFETY MANAGEMENT

Course Objectives

To teach the concept of safety and types and functions of safety organisation and to introduce the students to the different accident prevention methods.

Expected Outcomes

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

1. Understand the need for safety and the functions of safety organisation.
2. Develop a functional knowledge of the various accident prevention methods and work permit system.
3. Assess the safety performance of an organisation using various indices
4. Carry out an accident investigation and prepare a report

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. (1997). *Safety management in Industry*. Jaico Publishing House, New Delhi.
2. John V. Grimaldi and Rollin H.Simonds. (1989) *Safety management*. All India Traveller Book Seller, Delhi.
3. Ronald P. Blake. (1973). *Industrial safety.* Prentice Hall, New Delhi.
4. Ted S. Ferry. (1988). *Modern accident investigation and analysis*, John Wiley & Sons, Hoboken, N.J.
5. Alan Waring. (1996). *Safety management system*. Chapman & Hall, England.
6. National Safety Council. (1982). *Accident prevention manual for industrial operations*. Chicago.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15-1305: ELEMENTS OF MACHINE DRAWING

Course Objectives:
The objective of the course is to teach the concept of orthographical views which will enable him to interpret a drawing.

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

1. Draw the different views of threaded nuts and bolts, lock nuts and foundation bolts
2. Draw the orthographic views of pipe joints and detachable joints.
3. Make the assembly drawing of valves.

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

Type of Questions for End Semester Examination

Module I: Two questions A&B of 10 marks each with option to answer either A or B
Module II: Two questions A&B of 20 marks each with option to answer either A or B
Module III: Two questions A&B of 30 marks each with option to answer either A or B

SE 15-1305 SAFETY IN CONSTRUCTION

Course Objectives:

To understand the safety issues in various construction activities; the role of different stake holders and ergonomics in ensuring safety at construction site.

To learn about the safety requirements in various construction activities, material handling and in the operation/handling of construction related equipment.

To understand the legal requirements with respect to health, safety and welfare of workers at construction site.

Course Outcomes

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

1. Visualize the safety issues at different stages of construction activity.
2. Understand the safety requirements in various construction operations and develop guidelines to ensure safety at construction site.
3. Understand the safety requirements in material handling and equipments and develop guidelines to ensure safety at construction site.
4. Learn 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 – Relevance of ergonomics in construction safety.

Module II

Safety in various construction operations – Excavation and filling – Underwater works – Under-pinning & Shoring – Ladders & Scaffolds – Tunnelling – Blasting – Demolition – Confined space – Temporary Structures. Familiarisation with relevant Indian Standards and the National Building Code provisions on construction safety.

Module III

Safety in material handling and equipment – Safety in storage & stacking of construction materials. Safety in the use of construction equipment/vehicles – excavators, graders and dozers – cranes – hoists & lifts – other lifting gears wire ropes – chain-pulley blocks – mixers – conveyors – pneumatic and hydraulic tools in construction. Safety in temporary power supply and fire safety at construction site.

Module IV

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. Vaid, K.N., (1988). Construction safety management. National Institute of Construction Management and Research, Mumbai.
2. Davies, V. J., and Tomasin, K. (1996). Construction safety handbook. Thomas Telford Publishing, London.
3. Ratay, R. T. (1996). Handbook of temporary structures in construction (2nd edn.). Mc Graw-Hill, London.
4. Bureau of Indian Standards, (2005). SP-7: National Building Code of India 2005, Bureau of Indian Standards, New Delhi.
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.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 13 L1 FLUID MECHANICS AND MACHINERY LABORATORY

Course Objectives:
To provide practical knowledge in the verification of the principles of fluid flow and to gain knowledge in performance testing of hydraulic turbines and pumps.

Course Outcomes:

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

1. Gain a solid foundation in fluid flow principles
2. Conduct experiments in pipe flows and interpret data from model studies to prototype cases, as well as document them in engineering reports
3. Select proper machinery for fluid transportation.

1. Study of pipe fittings, and study of devices used for measurement of pressure, velocity, rate of flow, metacentric height and radius of gyration of floating bodies.
2. Experimental verification of Bernoulli's theorem.
3. Steady flow through pipes - determination of friction factor and Reynolds number.
4. Determination of the loss coefficients for pipe fittings.
5. Determination of hydraulic coefficients of mouth pieces, nozzles and orifices.
6. Calibration of venturimeter, orifice meter, nozzle and bend meters.
7. Determination of force due to impact of jets on vanes.
8. Determination of performance characteristics of centrifugal pumps at constant speed.
9. Determination of constant head characteristics of Francis turbine.
10. Determination of performance of hydraulic ram.

Note: 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be assessed by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

SE15–13 L2 SAFETY ENGINEERING LABORATORY

Course Objectives:

Through this instructional laboratory, the students will undertake exercises on selected topics of practical application in industries, viz., the use of personal protective equipment, assessment and comparison of the accident trends in industries, accident reporting, job safety analysis, safety audit, estimation of accident costs, work permit administration, EIA and environmental audit and preparing training modules on safety.

Course Outcomes:

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

1. Understand all about PPEs
2. Assess and quantify threats to safety and environment
3. Prepare different types of reports and permits
4. Prepare training modules on safety for workers and other classes of population in industry and society

List of Experiments:

1. Study of personal protective equipment
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.

Note: 50 % of the total marks is earmarked for continuous evaluation, and 50 % for end semester examination to be assessed by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

AS15- 1401 COMPLEX VARIABLES AND PARTIAL DIFFERENTIAL EQUATIONS
(Common to all branches)

Course Objectives:

To understand and use complex variables, function integrals, partial differential equation in engineering discipline.

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. (2010). *Advanced engineering mathematics*. (tenth edition). John Wiley & Sons, Hoboken, N.J
2. Grewal, B.S. (2013). *Higher engineering mathematics*. (forty third edition). Khanna Publishers, New Delhi.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE 15 - 1402 HEAT AND MASS TRANSFER OPERATIONS

Course Objectives:

To learn the different modes of heat transfer, and the concept of mass transfer operations employed in chemical industry.

Expected Outcomes:

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

1. Identify the different modes of heat transfer and carry out the conduction calculations in various geometries.
2. Calculate the design requirements of heat transfer in co-current and counter-current heat exchanger operations.
3. Identify the best possible separation method with the given parameters
4. Select the most suitable equipment for absorption, distillation, liquid-liquid extraction and solid-liquid extraction.

Module I

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer - Mean temperature difference. 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 a series of resistances - Analogy between flow of heat and flow of electricity.

Individual and overall heat transfer coefficients and the relationship between them.

Concept of heat transfer by convection - Natural and forced convection - Application of dimensional analysis for convection - Equations for forced convection under laminar, transition and turbulent conditions - Equations for natural convection -- Heat transfer from condensing vapours, 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 various types of heat exchangers.

Radiation: Concept of thermal radiations - Black body concept – Laws of radiation -concept of grey body – radiation between surfaces.

Evaporation: Types of evaporation - single effect and multiple effect evaporation - Design calculation for single and multiple effect evaporation.

Module III

Principles of mass transfer, Fick’s law of molecular diffusion, diffusion in solids and liquids. Concept of mass transfer coefficients, mass transfer at

fluids surfaces, correlation of mass transfer coefficients, theories of mass transfer and their applications, interphase mass transfer and over all mass transfer coefficients in binary systems.
Absorption - Equilibrium and operating line concept in absorption calculations; types of contactors, design of packed and plate type absorbers; Operating characteristics of stage wise and differential 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 of number of theoretical stages, total, minimum and optimum reflux.
Introduction to drying-equilibrium moisture and free moisture, critical moisture content, bound and unbound water, rate of drying curves, drying equipments-tray dryers, tower dryers, rotary dryers, fluid-bed dryers, spray dryers.
Principle of liquid-liquid extraction, liquid-liquid equilibrium, equipment for liquid extraction - mixer settlers, spray towers, Bollmann extractor.
Solid- liquid extraction- simple leaching, major equipments for solid -liquid extraction.

References:

1. Binay K.Dutta. (2001) *Heat Transfer principles and applications*. Prentice Hall of India, New delhi.
2. Robert E. Treybal. (2012). *Mass transfer operations*. (third edition). Mc Graw Hill Education, New York.
3. McCabe, W.L., J.C. Smith, J.C. and Peter Harriott. (2004). *Unit operations of chemical engineering*. (seventh edition). McGraw-Hill Education, New York.
4. Badger, W.L. and Banchero, J.T. (1997). *Introduction to chemical engineering*. Tata McGraw Hill Education, New Delhi.
5. Christe J. Geankoplis. (1993). *Transport process and unit operations*, Prentice Hall India Pvt Ltd, New Delhi.

Type of Questions for End Semester Examination
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE 15-1403 STRENGTH OF MATERIALS

Course Objectives

To learn the basic concept of stress, strain and their relationship in elastic bodies

To study the basic concept of calculating internal stresses and deformation characteristics of structural elements subjected to bending, torsion, and axial load

To study the basic concept of calculating internal stresses ad deformation characteristics of thin and thick walled cylinders and helical springs.

Expected Outcomes

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

1. Understand the fundamental concepts of stress and strain in elastic bodies subjected to external loads.
2. Analyse and calculate bending moments, shear forces, axial forces and deformation characteristics of determinate beams.
3. Solve engineering problems related thick pressure vessels.
4. 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 contraflexure.

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, 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. Gere, M.J. (2004). *Mechanics of Materials* (5th edn.). Thomson Asia Pte. Ltd., Singapore.
2. Popov, E.P. (1985). *Analysis of structures*. Khairna publishers.
3. Subramanian, R. (2005). *Strength of Materials*. Oxford University Press.
4. Ramamurtham, S. (2011). *Strength of Materials* (14th edn.). Dhanpat Rai and Sons.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE 15-1404 FIRE ENGINEERING FUNDAMENTALS

Course Objectives

To understand the basic theory of fire chemistry, the development of fire and its characteristics, and about different types of fire.
To study about the product of combustion and their characteristics.
To study about the use, operation and maintenance requirements of equipment, vehicles and accessories used in fire services.
To understand the fundamentals of fire hydraulics and fire ground operations

Course Outcomes

On successful completion of the course, the student will be able to
Understand the theory of fire chemistry; learn about different kinds of combustion and their characteristics
Learn about the products of combustion-flame, heat, smoke, fire gases- and their characteristics.
Acquire the knowledge about the use and operation of fire service equipment, machineries and accessories.
Calculate the water requirement and the pump capacity for fire fighting and understand 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, explosion;. Development of fire-incipient, smoldering, flame and heat stages; Diffusion flames-zones of combustion, smoldering combustion, characteristics of diffusion flame; Premixed flames-burning velocity, limits of flammability, explosion and expansion ratios, deflagration and detonation, characteristics of premixed flame; Explosion- physical explosion, chemical explosion; Special kinds of combustion- Flash fire, Pool fire, Deep seated fire, Spillover, Boil over, Dust explosion, BLEVE, UVCE; Classification of fire based on material.

Module II

Product of combustion-flame, heat, smoke, fire gases; Flame and its characteristics, spread of flames in solids and liquids, linear and three dimensional fire propagation; spread of fire in rooms and buildings; Effect of heat exposure to human body, body burns. Smoke – constituents of smoke, quantity and rate of production of smoke, quality of smoke, smoke density, visibility in smoke, smoke movement in buildings, modelling of smoke movement; Smoke control in buildings-natural and mechanical ventilation, pressurization; Design principles of smoke control using pressurization technique; Principles of smoke vent design.
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 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- Pumps, primers, crash tenders, rescue tenders, hose laying tenders, control vans, hydraulic platforms; Ladders- extension ladders, hook ladder, turntable ladders, snorkel; Uses and maintenance of small gear and miscellaneous equipments used during fire fighting; Lamps and lighting sets; Ropes and Lines- Types-wire and rope lines used in fire service. Use and testing of lines, knots, Bends and hitches; General rope work.

Module IV

Fire stream-path, range; nozzles-types, calculation of discharge capacity, nozzle reaction; Hydraulic and energy grade lines, pressure loss or gain because of elevation, back pressure; friction losses in pipes, fire hoses and fixtures, parallel and series connections; flow in pipes and 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 (1989). Underdowns practical fire precautions, Gower publishing company Ltd., England.
2. HMSO, (1991). Manual of firemanship-part 1 to 13. London.
3. Jain V.K. (2010). Fire safety in buildings (2nd edn.). New Age International (P) Ltd., New Delhi.
4. Barendra Mohan Sen (2013). Fire protection and prevention the essential handbook, UBS publishers and Dist., New Delhi.
5. Gupta, R.S.(2010). A Hand book of fire technology (2nd edn.). Universities Press
6. James F Cassey (1970). Fire service hydraulics (2nd edn.). Pennwell Books.
7. William E Clark (1991). Fire fighting principles & practices (2nd edn). Fire Engineering Books & Videos.
8. N F P A. Fire Protection Hand Book.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 - 1405 ELECTRICAL TECHNOLOGY AND SAFETY

Course Objectives:

To expose the students to the principles of operation of d.c and a.c machines and safety systems in various electrical installations.

Expected Course Outcomes:

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

1. Know the constructional and operational features of d.c machines and single phase transformers.
2. Understand the types and applications of synchronous machines, induction motors and circuit breakers.
3. Understand the working principle of fuses, and grounding and earthing mechanisms
4. Identify the safety precautions to be taken during installation of plant and equipment and understand the significance of hazardous zone classification and hazards of static electricity.

Module I

Construction and Principle of operation of d.c 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.

Construction and Principle of operation of single phase transformers – e.m.f equation – phase diagrams – equivalent circuit – regulation – losses and efficiency.

Protective relays – Requirement of relay – types of protection – classification – distance relay, differential relay, state relays.

Module II

Synchronous machines – types – e.m.f equation – winding factors – armature reaction and leakage resistance. Synchronous motor – methods of starting – applications.

Induction Motors – Construction and principle of operation – equivalent circuit – Torque – slip characteristics – method of starting – applications.

Circuit breakers – function of switch gear – arc phenomenon – initialization of an arc – arc interruption – recovery voltage and restriking voltage – MCB and ELCB. Faults in power systems – causes – types.

Module III

Fuses – types – selection – advantages and disadvantages.

Grounding – neutral grounding – solid grounding – resistance grounding – arc suppression coil grounding. Equipment grounding for safety – grounding substation – grounding of line structure. Earthing

Effect of electric and magnetic fields – Human safety aspects – effect of current and voltage on human beings – typical V-I characteristics of skin – Electric shocks and their prevention.
Insulation – classes of insulation – FRLS insulation – continuity test.

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. (2005). *Electrical technology*. (seventh edition). CBS Publishers and Distributors, New Delhi
2. Kothari, D.P. and Nagrath, I.J. (2009). *Basic electrical engineering*. (third edition). Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. National Safety Council. (1982). *Accident prevention manual for industrial operations*. Chicago.
4. Fordham-Cooper, W. (1998). *Electrical safety engineering*. Elsevier bv, Amsterdam.
5. Rao, S. and Saluja, H.L. (2012). *Electrical safety, fire Engineering and safety Management*, Khanna Publishers, Delhi.
6. *Indian Electricity Act & Rules*.

Type of Questions for End Semester Examination
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 - 1406 OCCUPATIONAL HEALTH AND FIRST AID

Course objectives:

To teach the significance of occupational health and hygiene.
To learn the fundamental principles of first aid.

Course Outcomes:

On completion of this course the students will be able to

1. Understand the concept and spectrum of health -functional units and activities of occupational health service.
2. Identify physical chemical and biological hazards in the work environment and its control measures.
3. Demonstrate the principles of first aid.
4. Understand 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.
2. *The industrial environment - its evaluation and control.* DHHS (NIOSH) publication number 74-117, 1973.
3. Clayton, C.D. and Clayton, F. (1981). *Patty's industrial hygiene and toxicology.* Wiley Inderscience, New York. :
4. Cantlie, James. (1932). *First aid to the injured*. St John Ambulance Association.
5. Yudenich,V.V. (1986). *Accident first aid,* Mir Publishers, Moscow.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE 15-14 L1 STRENGTH OF MATERIALS LABORATORY

Course Objectives

To apply the basic theory of stress and deformation in elastic bodies and thereby understand the behaviour of materials and elements subjected to different kinds of loads like axial tension, compression, torsion, shear, and impact.

Expected Outcomes

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

1. Understand the method of conducting experiments.
2. Observe and analyse data and arrive at conclusions.
3. Understand the basic concept of load and deformation in elastic bodies subjected to loads like axial force, bending and torsion.
4. Understand the hardness property and the effect of impact load on ductile materials.

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 tests- 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

Note: 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

SE15 14 L2 ELECTRICAL TECHNOLOGY LABORATORY

Course Objectives:
To impart knowledge on electric circuits, d.c. motors, single phase transformers, a.c motors, protective relays and circuit breakers.

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

1. Understand the laws governing electric circuits
2. Study the load and speed characteristics of d.c motors
3. Do load test on single phase transformer
4. Study the load and speed characteristics of a.c motors
5. Understand 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.

Note : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners .A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

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AS15 - 1501 NUMERICAL AND STATISTICAL METHODS
(Common to all branches)

Course Objectives:
To understand the concept of probability, statistics and numerical methods which arise in engineering application.

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

5. Solve algebraic and transcendental equations by numerical methods
6. Perform numerical differentiation and integration
7. Find the mean and variance of a probability distribution including the binomial distribution.
8. Use statistical tests in testing 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:
Erwin Kreyzig. (2010). *Advanced engineering mathematics*. (tenth edition). John Wiley & Sons, Hoboken, N.J
Grewal, B.S. (2013). *Higher engineering mathematics*. (forty third edition). Khanna Publishers, New Delhi.
Kandaswamy, P. Thilagavathy, K. and Gunavathy, K. (2007) *Numerical methods*. S Chand &Co, New delhi.

Richard A. Johnson. Irvin Miller and John E. Freund. (2010). *Probability and statistics for engineers*. (eighth edition). Pearson, New Delhi.

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 - 1502 CHEMICAL TECHNOLOGY AND REACTION ENGINEERING

Course Objectives:
To learn the manufacturing methods for various heavy chemicals and fertilisers and organic chemicals and to expose the students to the basics of reaction kinetics.

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

1. Analyse and improve the manufacturing methods for heavy chemicals and fertilisers
2. Analyse and improve the manufacturing methods for organic chemicals and polymers.
3. Analyse the batch reactor systems
4. Perform design calculations of CSTR and PFR

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, electric furnace 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). (2010). *Dryden's outlines of chemical technology for the 21st century*. (third edition). Affiliated East West Press, New Delhi.
2. George T. Austin. (1984). *Shreve's chemical process industries*. (fifth edition). McGraw- Hill Book Co Inc., New York.
3. Levenspiel, O. (2010). *Chemical reaction engineering*. (third edition). Wiley India Pvt. Ltd., New Delhi.
4. Scott Fogler, H. (2005). *Elements of chemical reaction engineering*. (fourth edition). (Prentice-Hall of India, New Delhi.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 - 1503 PRINCIPLES OF ENGINEERING DESIGN

Course Objectives:
To teach the practical considerations and the steps in the design process

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

1. Design threaded fasteners and detachable joints.
2. Design riveted and welded joints
3. Design springs and power shafts
4. Design 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 vessels for internal and external pressures- design of heads and enclosures- tall vessels- supports for vessels- non standard flanges- pipeline design. Design of storage tanks.

References:

1. Budynas, R.G. and Nisbett, K. (2014). *Shigley's Mechanical Engineering Design. (tenth* edition). Mc Graw Hill Book Co., New York.
2. Bhandari, V.B. (2010). *Design of machine elements*. Tata McGraw – Hill Education, New Delhi.

3. Myatt Donald, J. (1962). Machine design: an introductory text, McGraw Hill, New York.
4. Mahajani, V.V. and Umarji, S.B. (2014). Joshy's Process equipment design. (fifth edition). Trinity Press, New delhi.
5. Brownell, L. E and Young, E. H. (1995). *Process equipment design*, John Wiley & Sons, New York.
6. Bhattacharya, B.C. (2003). *Introduction to chemical equipment design - Mechanical aspects*. CBS Publishers and Distributors, New Delhi.

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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. K. Mahadevan, K. Balaveera Reddy, Design Data Handbook for Mechanical Engineers, 3rd Edition, CBS Publishers & Distributors, 2013.

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15-1504 PLANNING AND DESIGN OF FIRE PROTECTION SYSTEMS

Course Objectives

To understand the principle of different automatic fire detection systems and their application.
To learn about the principle of fire extinguishment and the performance of extinguishing agent.
To learn about the different types of first aid and portable fire protection system; their operation and maintenance requirements.
To learn about the details and design principle of fixed fire fighting systems with different extinguishers like water, CO_2, DCP and foam.
To learn about different types of fire alarm system.

Course Outcomes

On completion of this course the student will be able to

1. Understand the working principle of different types of fire detectors and will be able to select suitable fire detectors appropriate to the given situation.
2. Understand the concept of fire extinguishment and able to choose the proper type of first aid and portable fire protection system appropriate to the given situation.
3. Interpret the appropriate standards for the design, installation, inspection, testing and maintenance of fixed sprinkler systems as per Indian standard specifications.
4. Interpret the appropriate standards for the design, installation, inspection, testing and maintenance of fixed CO_2, DCP and foam systems as per Indian standard specifications.
5. Understand about the different types of fire alarm systems and about their requirements as per Indian standard specifications.

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; Comparison of detectors; Performance characteristics of detectors; Lag time associated with fire detection.

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.
First aid fire protection – fire bucket, sand bucket, fire blanket, hose reels; 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; Care, inspection, and maintenance of portable extinguishers as per relevant Indian standards specifications.

Module III

Automatic water sprinkler system- requirement and source of water supply, automatic pumps; Automatic 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; Principles of water sprinkler system design as per relevant standards (ISI).

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; Design principles of fixed fire fighting systems for total flooding and for local application as per relevant standards (ISI).
Fire alarm system- classification of alarm system as per NBC; Manually operated system; Automatic alarm system-Addressable and non-addressable system; Features of Local system, Auxiliary system, Remote station system, Central station system and Proprietary system.

References:

1. Ron Hirst (1989). Underdowns practical fire precautions, Gower publishing company Ltd., England.
2. Jain V.K. (2010). Fire safety in buildings (2nd edn.). New Age International (P) Ltd., New Delhi.
3. Barendra Mohan Sen (2013). Fire protection and prevention the essential handbook, UBS publishers and Dist., New Delhi.
4. William E Clark (1991). Fire fighting principles & practices (2nd edn.) Fire Engineering Books & Videos.
5. N F P A. Fire protection hand book
6. Relevant IS codes

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

SE15 - 1505 MANUFACTURING PROCESSES

Course Objectives:

To learn about the various engineering materials, their properties and properties modification methods ; various manufacturing processes and corresponding equipment and machineries used in engineering industries.

Course Outcomes:

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

1. Knowledge of various engineering materials, properties and properties modification methods.
2. Knowledge of various welding processes and the equipment's; Gas cutting, NDT of weldments
3. Knowledge of various metal casting methods and equipment and NDT of castings
4. Knowledge of various metal forming methods and equip; various metal cutting methods and machines.

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.

Text Books:

1. Kalpakjian, S. and Schmid S.R. (2009). *Manufacturing Engineering and Technology*, (sixth edition). Pearson Education Asia.
2. Sharma P.C. (2007). A *Text Book of Production Technology*. S. Chand &

Co, New Delhi.

References:

1. *Welding Handbook: Vol. I to V.* American Welding Society.
2. Hein, Lopper. and Rosenthal. (2001). *Principles of Metal Casting.* (second edition). McGraw Hill Education (India) Private Limited.

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 - 1506 CHEMICAL PROCESS SAFETY

Course Objectives

To teach the principles of safety applicable to the design, and operation of chemical process plants.

Course Outcomes:

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

1. Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants..
2. Develop thorough knowledge about safety in the operation of chemical plants.
3. Apply the principles of safety in the storage and handling of gases
4. Identify the conditions that lead to reaction hazards and adopt 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 startup 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 inerting, venting, explosion relief, flame arrestors, explosion suppression, Classification of hazardous areas.

References:

Ralph King and Ron Hirst. (1998). *King's safety in the process industries*. Arnold, London.

1. *Industrial Environment and its Evolution and Control*, NIOSH publication, 1973.
2. National Safety Council. (1982). *Accident prevention manual for industrial operations*. Chicago.
3. Lewis, Richard. J., Sr. (1996). Sax's dangerous properties of materials. (ninth edition). Van Nostrand Reinhold, New York.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 15 L1 CHEMICAL ENGINEERING LABORATORY

Course Objectives:

To understand the practical aspects of the various unit operations employed in chemical industry.

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

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 a 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.

<u>Note</u> : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners .A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

SE 15 L2 FIRE SAFETY TRAINING

Course Objectives

The objective of the course is to expose the students to the various techniques of fire fighting.

Course Outcomes

On completion of the course the student will be able to

1. Understand the operation of fire service equipment
2. Fight fires using extinguishers.
3. Refill the used extinguishers
4. Demonstrate the use of hoses and take part in hose drills.
5. Demonstrate the use of different knots and hitches.

The following techniques of fire fighting shall be demonstrated to the students by experienced fire services professionals.

1. Study and demonstration of different types of knots, bend and hitches used in fire fighting.
2. Study and demonstration of fire fighting equipment.
3. Study of different fire fighting vehicle.
4. Fire Fighting with CO2 extinguisher
5. Fire fighting with water type extinghisher.
6. Fire Fighting with DCP extinguisher.
7. Fire fighting with foam extinguisher
8. Refilling different types of extinguishers
9. Study and demonstration of hoses, couplings and braches
10. Hose drills (dry) – laying one hose, connection and disconnection couplings.
11. Table top exercise-scenario based fire fighting.

<u>Note</u> : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners .A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

SE15–1601 LEGAL ASPECTS OF HSE

Course Objectives:

To be aware of and to gain insight into the laws relating to industries, docks and harbours, labour welfare and environment protection. On successful completion of this course the students will be able to prepare legal compliance registers appropriate to their industries or organisations.

Course Outcomes:

On completion of this course, the student will be able to understand and apply the knowledge of

1. Substantive provisions relating to factories and docks
2. Important social security provisions for industrial workers and general public
3. Important legal provisions related to handling of explosives and petroleum
4. Major legislations relating to the environment protection

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.

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.

Note: Case laws may be referred if necessary, but those are beyond the scope of this course.

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.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 - 1602 PROCESS INSTRUMENTATION AND CONTROL

Course Objectives:
The aim of the course is to impart the principles of measurement used in industries and research, classification of instruments, analysis of process parameters and design of control systems for open loop and closed loop systems and their application in chemical industries.

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

1. Acquire knowledge about the measurement principles and techniques of measuring temperature and pressure.
2. Identify suitable methods for the measurement of flow, level, pH and humidity.
3. Understand the open loop and closed loop 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 – Bode Plot.

Module IV

Introduction to stability – Definition via impulse response function – Routh-Hurwitz stability criterion – Nyquist stability criterion.

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. (1996). *Principles of industrial instrumentation*. (second edition). Tata McGraw-Hill Publishing Company Ltd, New Delhi.
2. Eckman, D. P. (1990). *Industrial instrumentation*. Wiley Eastern Ltd, New Delhi.
3. George Stephanopolous. (1990). *Chemical process control: An introduction to theory and practice*. Prentice Hall of India Pvt. Ltd.
4. Coughanowr, C.R. and Koppel, L.M. (1998). *Process system analysis and control*. McGraw Hill, New York.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 - 1603 HAZARD CONTROL IN MANUFACTURING

Course Objectives:
To learn about the various hazards associated with the manufacturing processes employed in engineering industries and methods used to safeguard the operators and others

Course Outcomes:
On completion of the course the student will be able to have
1. Knowledge of various hazards associated with hot working of metals and methods of cotrol
2. Knowledge of various hazards associated with cold working and cutting of metals and methods of control
3. Knowledge of various hazards associated with welding and cutting of metals and methods of control
4. Knowledge of various material handling methods and systems; the hazards and methods of control

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:

National Safety Council. (1982). *Accident prevention manual for industrial operations*. Chicago.
Ronald P. Blake. (1973). *Industrial safety.* Prentice Hall, New Delhi.
Balchin, N.C. (2005). Health *and Safety in Welding and Allied process*, Jaico Publishers, New Delhi.
Kalpakjian, S and Schmid S.R. (2009). *Manufacturing Engineering and Technology*, (sixth edition). Pearson Education Asia.

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE 15-1604 STRUCTURAL FIRE SAFETY

Course Objectives

To learn about the effect of fire on materials used for construction, the method of test for non-combustibility & fire resistance and to learn about the approximate method of calculation of fire resistance rating of structural elements

To learn about fire area, fire stopped areas and different types of fire resistant doors

To learn about the method of fire protection of structural members and their repair due to fire damage.

Course Outcomes

On completion of the course the student will be able to

1. Understand the effect of fire on materials used for construction
2. Understand the method of test for non-combustibility and fire resistance; and will be able to select different structural elements and their dimensions for a particular fire resistance rating of a building.
3. To understand the design concept of fire walls, fire screens, local barriers and fire doors and able to select them appropriately to prevent fire spread.
4. To decide the method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.

Module I

Compartment fire-factors controlling fire severity, ventilation controlled and fuel controlled fires; Spread of fire in rooms, within building and between buildings.

Effect of temperature on the properties of structural materials- concrete, steel, masonry and wood; Behaviour of non-structural materials on fire- plastics, glass, textile fibres and other house hold materials

Determination of combustibility by fire tube method; Brief description on non-combustibility test and classification of flame spread rate of materials as per relevant standards (BIS).

Module II

Compartment temperature-time response at pre-flashover and post flashover periods; Equivalence of fire severity of compartment fire and furnace fire; 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 methods for calculating the fire resistance of structural elements- Schematic diagrams, influencing factors; Principle of calculation of the fire resistance limits of structures; Approximate calculation of the

required fire resistance for a building; Method of arriving at the required fire resistance of structural members as per BIS.

Module III

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 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 relevant standards (ISI).

Module IV

Fabricated fire proof boards-calcium silicate, Gypsum, Vermiculite, and Perlite boards; Fire protection of structural elements – Wooden, Steel and RCC..

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.

References:

1. Roytman, M. Ya. (1975). Principles of fire safety standards for building construction. Amerind Publishing Co. Pvt. Ltd., New Delhi
2. Smith, E.E. and Harmathy, T.Z. (Editors), (1979). Design of buildings for fire safety. ASTM Special Publication 685, American Society for Testing and Materials, Boston, U.S.A.
3. Butcher, E. G. and Parnell, A. C. (1983). Designing of fire safety. John Wiley and Sons Ltd., New York, U.S.A.
4. Jain, V.K.(2010). Fire safety in buildings (2nd edn.). New Age International (P) Ltd., New Delhi.
5. John A. Purkiss (2009). Fire safety engineering design of structures (2nd edn.), Butterworth-Heinemann, Oxford, U.K.
6. Relevant IS codes

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 - 1605 ENVIRONMENTAL ENGINEERING AND MANAGEMENT

Course Objectives:

To learn the various engineering techniques and management approaches for the prevention and control of air pollution, water pollution and pollution due to urban solid waste and hazardous waste.

Course Outcomes:

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

1. Attain ability to choose the most suitable technique for air pollution monitoring and control technique for a given application.
2. Demonstrate an ability to recognise the type of unit operations and unit processes involved in wastewater treatment plants
3. Identify the techniques for the disposal and management of urban solid wastes and hazardous wastes
4. Demonstrate the ability to recognise 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. Clean development mechanism (CDM) – carbon trading.

References:

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

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 1606 E1 POWER PLANT ENGINEERING

Course Objectives:
To learn the different aspects of power generation, power supply, cost of energy and non-conventional energy sources.

Course Outcomes:
On completion of this course the student will be able to
1. Have a general understanding of the scale and scope of hydroelectric power plants, steam power plants, diesel power plants, gas turbine power plants and nuclear power plants.
2. Comprehend the complexity of the power plants and its components and elements.
3. Understand the safety issues related to power plants and the current scenario of national and international debates on the same.
4. Gain knowledge of 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. Verma Mahesh, Power Plant Engineering, Metropolitan Book Co.
6. Rai G D, Non-Conventional Energy Sources, Khanna Publishers, 2011.
7. Saravanamuttoo HIH, Rogers GFC, Cohen H, Straznicky PV, Gas Turbine Theory, 6th edition, Prentice Hall, 2008.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 1606 E2 SAFETY IN PETROLEUM AND PETROCHEMICAL INDUSTRIES

Course Objectives:

To teach the various processes employed in petroleum refining and in the manufacture of petrochemicals and the fire prevention and fire protection methods employed in storage tank farms, depots, and terminals and on-shore and off-shore drilling.

Course Outcomes:

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

1. Identify the various processes employed in petroleum refining and petrochemical industries
2. Attain ability to design fire protection systems for storage tank farms
3. Attain ability to design fire protection facilities in oil refineries, depots and terminals
4. Demonstrate an ability to recognise the hazards involved in on-shore and off-shore drilling

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). (2010). Dryden's outlines of chemical technology for the 21st century. (third edition). Affiliated East West Press, New Delhi.
2. Sam Mannan (Editor). (2012). *Lee's loss prevention in the process industries*. (fourth edition). Butterworth-Heinemann Ltd., UK.
3. Davorin Matanovic. Nedilika Gaurina– Medjimurec. And Katarina Simon. (Editors). (2014). *Risk analysis for prevention of hazardous situations in petroleum and natural gas engineering*. Engineering Science Reference, Hershey PA.
4. Aven, T. and Vinnem, J.E. (2007). *Risk management with applications from the offshore petroleum industry*. Springer-Verlag, U.K.
5. Manuel of Fireman ship – Vol. I to XIII, HMSO, London.
6. Fire Protection Hand book. NFPA, 2008.
7*. OISD Standards.*

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

E15 1606 E3 FOOD AND BIOSAFETY

Course Objectives:

To learn the chemical, technological and toxicological aspects of food additives and food contaminants and the legal and socio-economic aspects of biotechnology.

Course Outcomes:

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

1. Identify 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. Attain knowledge about the national and international regulations for biosafety.
4. Demonstrate an ability to recognise 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, biopesticides 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. (2002). *Food Safety Handbook*. 1st edition, Wiley.
2. Norman G. Marriott and Robert B. Gravani. (2006). *Principles of Food Sanitation*. 5th edition. Springer.
3. Sateesh, M.K. (2008). *Bioethics and Biosafety*. I.K. International Pvt Ltd., New Delhi.
4. Thomas, J. A. and Fuchs, R.L. (2002). *Biotechnology and Safety Assessment*. (3rd Edition). Academic Press.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 1606 E4 FAULT DETECTION AND DIAGNOSIS

Course Objectives

To learn the different approaches to fault detection and diagnosis.

Course Outcomes.

On completion of this course the student will be able to

1. Understand the different issues involved in FDD and applications.
2. Gain basic knowledge on design of structured residuals
3. Have fundamental knowledge about design of directional structured residuals
4. Understand 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. (1998). *Fault Detection and Diagnosis in Engineering systems*. (2nd Edition). Marcel Dekker.

2. Sachin. C. Patwardhan. (2005). *Fault Detection and Diagnosis in Industrial Process*" – Lecture Notes, IIT Bombay.
3. Rami S. Mangoubi. (1998). *Robust Estimation and Failure detection*. Springer-Verlag, London.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

E15 1605 E5 FIRE DYNAMICS

Course Objectives:
The objective of the course is to teach the fundamentals of heat release in a fire, fir plumes and flames, pressure profiles and smoke filling.

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

1. Give qualitative description of fire sequence, ignition, flames spreading, heat release rate, mass burning rate, time dependency of heat release rate and effect of the enclosure on heat release rate etc.
2. Recognise the importance of fire plumes, flames, mean flame height, flame height co relations plumes co relations, ceiling jets etc.
3. Develop understanding on pressure profiles and air-flow in buildings
4. Attain knowledge about smoke filing, pressure build in the fire enclosure, transient smoke filing models, effect of sprinklers on smoke filing and its correlations, fire safety engineering system for handling and control of combustion gases and CFD models.

Module I
Qualitative description of a fire sequence. Ignition, flame spreading. Various ways of categorising a fire. The effect of the building on the fire.
Heat release rate. Mass burning rate and time-dependency of the heat release rate, the order of magnitude of the heat release rate, the strengths and weaknesses of various test methods, growth of alfa-t2, the effect of the enclosure on the heat release rate, extraction of a power curve.

Module II
Fire plumes and flames. Froude number, mean flame height, flame-height correlations, various profiles in a plume, ideal plumes, strong and weak plumes, plume correlations, ceiling jets, special issues to be considered in the design process, quasi-stationary conditions, selecting a plume model.

Module III
Pressure profiles. Background on air-flow in buildings. Bernoulli's equation. Various forms of pressure. Computing pressure, rate and mass air-flow through openings.
Gas temperatures. Energy balance, rate of heat transfer, correlations for computing gas temperatures. Fully-developed fires, ISO 834, temperature calculation. The influence of high temperatures on structural elements of steel or wood.

Module IV
Smoke filling. Pressure build-up in the fire enclosure. Transient smoke filling models. Stationary models for control of combustion gases. Various fire

safety engineering systems for handling and control of combustion gases. Continuity equations. Effect of sprinklers on smoke filling. Correlations.
Combustion products. Equivalency ratios. Soot production. Visibility, dosage. How soot particles are formed. CO, CO2.
Computer modelling. Sub-models for computer models. Model constraints. CFD models.

References:

1. Karlsson, B., Quintiere, J G: Enclosure Fire Dynamics. CRC Press, 1999.

Type of Questions for End Semester Examination
PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE 16 L1 MACHINE SHOP

Course Objectives:

Through this laboratory the students will study the construction and working of machine tools like lathes, shapers, drilling machines, grinding machines, power hack saws and milling machines. The students will have hands on experience in working on lathe, shaper, slotting machine, drilling machine, milling machine and surface grinding machine and study about and learn to use measuring instruments. On successful completion of the course the student will have confidence to operate various machine tools and have knowledge about the hazards associated with machine tools and the mitigation measures and PPEs used.

Course Outcomes:

On completion of the course the student will have
1. Knowledge of construction and working of lathes and will be able to operate lathe and do models and use measuring instruments
2. Knowledge of construction and working of shaper and slotting machine and will be able to operate and do models in them and use measuring instruments
3. Knowledge of construction and working of drilling machine and milling machine and will be able to operate and do models in them and use measuring instruments
4. Knowledge of construction and working of surface grinding machine and will be able to operate and do models and use measuring instruments

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.
2. Burghardt, Axllered and Anderson. *Machine tool operations 1 & 2*
3. Reddy,Venkart. (2014).Workshop Practice Manual, BSP Books.
4. Goyat S.P Mechanical Engineering Workshop Practice Laboratory Manual-1, Abhishek Publications,Chandigarh

Note : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners .A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

SE15 16 L2 ENVIRONMENTAL ENGINEERING & MANAGEMENT LABORATORY

Course Objectives:

To understand the concepts for estimating the different parameters of air and water quality

Course Outcomes:

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

1. Attain the ability to determine the physical, chemical and biological characteristics of water and waste water
2. Attain the ability to assess the quality of stack emissions as well as ambient air
3. Identify the suitable methods for pollution prevention and control in industries.

1. Determination of pH, turbidity, total hardness, total solids and dissolved oxygen of water samples.

2. Determination of BOD and COD of waste water samples.

3. Jar test for determining the optimum coagulant dose for water treatment.

4. Determination of kinetic constants of activated sludge process.

5. Determination of sulphur dioxide, oxides of nitrogen and particulate matter from chimney sources.

6. Determination of particulate matter, chlorine, ammonia, carbon monoxide and sulphur dioxide in ambient air.

7. Analysis of lead and other heavy metals in air using spectroscopy.

8. Study of pollution prevention and control facilities in industries.

9. Preparation of Environmental Impact Statement (EIS) for an industrial project.

10. Preparation of an Environment Audit Report.

Note : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners .A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

SE15 1701 HAZARD IDENTIFICATION AND RISK ASSESSMENT

Course Objectives:
To learn the various techniques for hazard identification, reliability analysis, estimation of frequency of occurrence of hazards, consequence analysis, risk quantification and human reliability analysis.

Course outcomes:
Upon completion of this course the student would be able to:

1. Attain the ability to use the hazard indices, HAZOP, PHA and What if analysis for the identification of hazards in a process
2. Attain the ability to assess probability of occurrence of an event using fault tree and event tree analysis
3. Estimate the consequences of fire, explosion and toxic gas release using suitable empirical models
4. Quantify the risk involved in a process

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. AIChE/CCPS. (1992). *Guidelines for Hazard Evaluation Proce*dures. (second edition). Centre for Chemical Process Safety, American Institute of Chemical Engineers, New York.
2. AIChE/CCPS. (2000). Guidelines *for Chemical Process Quantitative Risk Analysis.* (second edition). Centre for Chemical Process Safety, American Institute of Chemical Engineers, New York.
3. Sam Mannan (Editor). (2012). Lee's Loss Prevention in the Process Industries. (fourth edition). Butterworth-Heinemann Ltd., UK.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15–1702 TRANSPORTATION SYSTEMS AND SAFETY

Course Objectives:

To learn the basic working principles involved in various transportation systems and their safety aspects and to be able to identify defects in planning and design of transportation systems.

Course Outcomes:

On successful completion of this course the student will develop a broad understanding of the

1. Working of railways and safety aspects in railway operation
2. Basic geometric design features of roads
3. Traffic studies and traffic safety
3. 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. (2012). *Railway Engineering*. Charotar Book Distributors, Anand.
2. Chandra, S. & Agarwal, M. M. (2007). *Railway Engineering*. Oxford University Press, New Delhi.
3. Khanna, S. K. and Justo, C. E. G. (2001). *Highway Engineering (9th ed)*. Nem Chand & Brothers, New Delhi.
4. Kadiyali, L. R. (2004). *Traffic Engineering and Transport Planning*. Khanna Publishers, New Delhi.
5. Srinivasan, R. (2013). *Harbour, Dock and Tunnel Engineering*. Charotar Publishing House Pvt. Ltd, Anand.

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 - 1703 PRINCIPLES OF INDUSTRIAL MANAGEMENT

Course Objectives:

To learn the basic principles, elements and functions of industrial management. On successful completion of the course the student will be aware of the various aspects of management and would be equipped with the knowledge to manage men and systems.

Course Outcomes:

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

1. Knowledge of various aspects of organisation and principles of scientific management
2. Knowledge of different functions of human resource management including motivation and leadership
3. Knowledge of various aspects of production management like forecasting, production systems, inventory control and PPC
4. Knowledge of important aspects project management like appraisal, feasibility study, project report and network analysis.

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 (2004). *Principles of Management*. Tata McGraw Hill Education.
2. Buffa, E.S. (1983). *Modern Production and Operations Management*. (seventh edition). John Wiley and Sons.
3. Prasanna Chandra. (1995). *Projects Planning, Analysis, Selection, Implementation & Review*. (4th edn). Tata Mcgraw Hill, New Delhi.
4. Martand Telsang. *Industrial Engineering and Production management*. (2nd edn). S.Chand & Co., New Delhi.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE 15-1704 LIFE SAFETY IN BUILDING FIRE

Course Objectives

To learn about the human behaviour under emergency movement and to plan evacuation routes and exits.

To learn about the various fire and life safety requirements; planning and distribution of portable & fixed fire fighting systems in buildings as per BIS

To learn about the need and procedure for fire investigation, arson identification, fire training, fire safety audit and fire risk assessment.

Course Outcomes

On completion of this course the student will be able to

1. Understand the human behaviour under emergency movement and the concept of planning and design of seating arrangements in assembly buildings, evacuation routes and exits.
2. Understand the general life safety requirements applicable to all buildings and to plan, design and locate exits in buildings.
3. Understand the fire and life safety requirements for buildings of specific occupancy.
4. Plan and distribute portable and fixed fire fighting systems in buildings of different occupancies as per BIS
5. Understand 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; Stages of evacuation; Planning and design of evacuation routes and exits; planning of seating arrangements in large assembly buildings.

Module II

Classification of buildings based on occupancy and type of construction according to fire resistance as per NBC; Fire zone; General fire safety requirements applicable to all individual occupancies.

General exit requirements as per NBC; Internal staircases; horizontal exits; fire tower; ramps; fire lifts; external fire escape ladders; Planning of location and calculation of capacity, number and width of exit as per NBC for different occupancy classification.

Module III

Fire and life safety requirements in different groups of buildings-Hotel, Schools & Colleges, Hospitals, Theatres, Shopping malls, etc.; Fire protection and prevention in high rise buildings; Fire protection in underground structures and in buildings under construction.

Sitting of detectors as per relevant Indian standard specifications; Selection and planning of alarm system as per relevant standards (BIS). General requirements and guidelines for the installation of fire detection and alarm system in buildings of different occupancy classification.

Module IV

Selection and distribution of portable extinguishers (for class A and B fires) and other fire protection equipment and systems for different occupancy classification as per NBC; Planning of fixed fire fighting installation for different occupancy classification- sprinkler system; total flooding system; CO_2 system; foam system;

Fire Investigation; Detection of arson; Fire training and education- fire drill, fire order; - Fire safety audits; Fire risk assessment.

References:

1. Roytman, M. Ya.(1975). Principles of fire safety standards for building construction. Amerind Publishing Co. Pvt. Ltd., New Delhi
2. Butcher, E. G. and Parnell, A. C.(1983). Designing of fire safety. John Wiley and Sons Ltd., New York, U.S.A.
3. Jain, V.K.(2010). Fire safety in buildings (2nd edn.). New Age International (P) Ltd., New Delhi.
4. Barendra Mohan Sen(2013). Fire protection and prevention the essential handbook. UBS Publishers and Dist., New Delhi.
5. Relevant IS codes

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 - 1705 E1 RELIABILITY ENGINEERING

Course Objectives:

To learn the principles and applications of reliability engineering. On successful completion of the course the student will be able to understand failures and measures of reliability of components and systems, methods of reliability improvement, fault tree analysis and maintainability and availability of systems.

Course Outcomes:

On successful completion of the course the student will be able to have

1. Knowledge of failures and measures of failures like MTTF, MTBF and analysis of failure data.
2. Knowledge of different hazard models, Bayes theorem.
3. Knowledge of system reliability for different configurations, redundancy and repairable systems.
4. Knowledge of fault tree analysis, tie-sets& cut-sets, maintainability and availability and maintenance planning.

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.

Text Books:

1. L.S. Srinath, Reliability Engineering, Affiliated East-West Press, New Delhi, 2005
2. A.K.Govil, Reliability Engineering, Tata Mc-Graw Hill, New Delhi, 1983

Reference Books:

1. L.Balagurusamy, Reliability Engineering,Tata Mc-Graw Hill, New Delhi, 1984.
2. S. Rao, Reliability Based Design, Mc-Graw Hill, 1992.
3. K.C. Kapur and L.R. Lamberson, Reliability in Engineering Design, Wiley Publications, 1977.
4. D.J. Smith, Reliability Engineering, 1972, E.W. Publications.

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 - 1705 E2 AUTOMOBILE ENGINEERING AND SAFETY

Course Objectives:

To learn basics of automobile engineering and provisions of CMV rules. On successful completion of the course the student will be understand the working of automobiles consisting of engines, transmission systems, chassis, lubricating and cooling systems, electrical and fuel systems and HVAC systems . The student will be able to understand the various provisions of CMV rules concerning the systems and safety of automobiles

Course Outcomes:

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

1. Knowledge of automobile engines, fuel systems and CMV rules for proto type testing and emission standards.
2. Knowledge of electrical systems -ignition, lighting, horn, wipers, HVAC and concerned CMV rules
3. Knowledge of transmission systems - clutch, gearbox, steering, and differential. Chassis-springs, axles and brakes and corresponding CMV rules.
4. Knowledge of lubricating systems, cooling systems and miscellaneous systems. CMV rules for 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. GBS Narang, *Automobile Engineering, Khanna Publishers,Delhi, 2014*
2. Kirpal Singh, *Automobile EngineeringVol.I &II. Standard publishes-distributors-Delh,13h ed,2012*
3. Joseph Heitner, *Automotive Mechanics-Principles & Practices,CBS Publisher-Delhi; 2 ed. 2006*
4. P. L. Kohli, Automotive *Electrical Equipments*.Mcgraw Hill Education, New Delhi, 1993
5. *The Central Motor Vehicles Rules, 1989*

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 1705 E3 INDUSTRIAL ECOLOGY

Course Objectives

To learn the concept of industrial ecology and the relevance of ecology to technology

Course Outcomes

On completion of this course the student will be able to

1. Understand the concept of industrial ecology
2. Identify environmental interactions during product use
3. Understand the methodology of LCA
4. Gain knowledge about metabolic and resource analysis

Module I

Humanity and the Environment - The Industrial Ecology Concept - Technological Change and Evolving Risk.
The Relevance of Biological Ecology to Technology- The Status of Resources - Governments, Laws, and Economics

Module II

Industrial Product & Process Design and Operation - Choosing Materials - Designing for Energy Efficiency.
Product Delivery -Environmental Interactions During Product Use - Design for End of Life.

Module III

An Introduction to Life-Cycle Assessment - The LCA Impact and Interpretation Stages - Streamlining the LCA Process.
Using the Corporate Industrial Ecology Toolbox - Managing Industrial Ecology in the Corporation- Indicators and Metrics - Services Technology and Environment

Module IV

Industrial Ecosystems - Metabolic and Resource Analyses - Systems, Analysis, Models and Scenario Development.
Earth Systems Engineering and Management - The Future of Industrial Ecology.

Reference:

1. Graedel, T.E. and Allenby,B. R. (2003). *Industrial Ecology*. (2nd edition). Prentice-Hall.

2. Graedel, T.E. and Allenby,B. R. (2010). *Industrial Ecology and Sustainable Engineering*. Pearson.

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 - 1804 E1 FLUID POWER SAFETY

Course Objectives:
To learn basics of hydraulics and pneumatics. On successful completion of the course the student will have knowledge of working of hydraulic and pneumatic systems, the associated hazards and the corresponding safety measures.

Course Outcomes:
On successful completion of the course the student will be able to have
1. Knowledge of Basics of power hydraulics, hydraulic fluids, pumps, actuators, reservoirs and piping and related safety precautions
2. Knowledge of fluid control valves-direction, pressure and flow and associated hazards and safety measures.
3. Knowledge of basics of pneumatics, compressors, actuators, control valves and pneumatic circuits
4. Knowledge of hydraulic, pneumatic, hydro pneumatic and electrohydraulic circuits and safety.

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.

Text Books:

1. Majumdar.S.R. *Oil hydraulic Systems– Principles & Maintenance*,

Mcgraw Hill Education, 2001
2. Majumdar. S. R. *Pneumatic Systems – Principles & Maintenance*, Mcgraw Hill Education, 1995
3. Esposito, Anthony. Fluid Power with applications, Pearson Education Asia

References:

1. Jagadish Lal. *Hydraulic Machines*. Metropoliton Books, 1994
2. J.Pippenger & T. Hicks. *Industrial Hydraulics.* McGraw Hill,1980

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 1705 E5 EXPLOSIVES TECHNOLOGY AND SAFETY

Course Objectives

To teach the fundamental principles of explosives and the safety aspects of explosives operations, storage and transportation

Course Outcomes

On completion of this course the student will be able to

1. Understand the chemistry of explosives and the mechanisms of burning
2. Gain knowledge on the concepts of shock, detonation and initiation
3. Apply scaling in design and analysis of explosive devices
4. Understand 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:

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

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE 15-17 L1 FIRE ENGINEERING LABORATORY

Course Objectives

To learn about testing standards for the test on DCP, foam and performance tests of portable extinguishers

Course Outcomes

On completion of this course the student will be able to

1. Understand the method of conducting experiments.
2. Observe and analyse data and arrive at conclusions.
3. Demonstrate understanding of the method of tests for DCP
4. Demonstrate understanding of the method of tests for CO_2

List of Experiments

1. Determination of flash Point, fire point and pour point of hydrocarbons.
2. Tests on Dry Chemical Powder as per relevant Indian standard specifications
3. Performance Tests on Portable DCP Fire Extinguishers (Cartridge Type)
4. Performance Tests on Portable CO_2 Fire Extinguishers
5. Tests on Foam as per relevant Indian standard specifications
6. Test of non-combustibility of Building Materials.

Note : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners .A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

SE 17 L2 INDUSTRIAL HYGIENE LABORATORY

Course Objectives
To learn the techniques of assessing the quality of the work environment

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

1. Evaluate the different pollutants in the atmosphere using air sampling equipment
2. Evaluate heat stress in industries
3. Measure different physical hazards such as noise, illumination etc.

List of Experiments:

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

Note : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners .A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

GE 15 17L3 ENTREPRENEURSHIP DEVELOPMENT

Course Objectives:
Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc.

Course Outcomes:
On completion of this course the student will be able to
1. Develop awareness about the importance of entrepreneurship opportunities available in the society
2. Get acquainted with 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. (2011). *Entrepreneurship*. (second edition). Oxford University Press, New Delhi.
2. Gordon, E. and Natarajan, K. (2007). *Entrepreneurship development*. (fourth edition). Himalaya Publishing House, New Delhi.
3. Coulter Mary. (2008). *Entrepreneurship in action*. (second edition). PHI Learning, New Delhi.
4. Jain, P.C. (2003). *Handbook for new entrepreneur*. Oxford University Press, New Delhi.
5. Khanka, S.S. (2013). Entrepreneurial development. (fifth edition). S. Chand and Co, New Delhi.

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

SE15–17 L3 COMPUTATIONAL LABORATORY

Course Objectives:

To familiarise the students on the use of computer-aided drafting tool to draw basic figures, to teach them how to use computer programs and packages for the analysis, graphical presentation and interpretation of data, and give hands-on practice on softwares on fire and smoke modelling

Course Outcomes:

On completion of the course the student will be able to

1. Draw basic figures using CAD
2. Use spreadsheets for analysis and modelling
3. Use risk analysis software
4. Use software packages for fire dynamics simulation and modelling

List of Experiments:

1. Computer aided drafting (CAD)
2. Use of spread sheets in computation of empirical and molecular formulae, heat of mixing and vapour pressure.
3. Use of spread sheets for statistical analysis of data – regression, analysis of variance and interpolation.
4. Use of statistical software packages like SPSS and ANOVA for data analysis.
5. Applications of risk analysis software like ALOHA.
6. Programming in MATLAB/SCILAB to solve fault tree and fire dynamics problems
7. Graphical representation of various data related to safety and fire engineering.
8. Linear Programming, transportation, assignment and dynamic programming in fire engineering – formulation and solution through PC based programs.
9. Fire and smoke modeling and simulation using the following open source softwares
    (a) NIST Fire Dynamics Simulator (FDS) and Smoke View.
    (b) ALOFT – FT
    (c) CFAST

<u>Note</u> : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners .A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

SE15 1801 HUMAN FACTORS ENGINEERING

Course Objectives:
To learn how man, machine and environment interact effectively to make the work and workplace better for ease of work and to maximise production.

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

1. Understand human information processing ability and the parameters influencing it.
2. Gain knowledge about information receptors and the visual and auditory displays.
3. Understand physical work load, energy consumption for various works, motor skills and hand tool design.
4. Apply workspace design and arranging 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. (1993). *Human factors in engineering & design,* (seventh edition). McGraw-Hill, New York.
2. Martin Helander. (1996). *A guide to ergonomics of manufacturing*. Tata McGraw Hill, New Delhi.
3. Bridger, R.S. (2008). Introduction to ergonomics. (third edition). CRC Press

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 1802 ADVANCED SAFETY ENGINEERING AND MANAGEMENT

Course Objectives:
To give an overview of a few emerging techniques in safety engineering and management.

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

1. Analyse domino effects and conduct MORT analysis
2. Analyse the layer of protection required for process industries
3. Gain knowledge on essential elements of plant security
4. Understand the concept of behavior based safety

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 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 Management – people based safety, BBS experience, Outocmes of BBS work, psychology of BBS, Implementation problems in BBS, 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. ACC: *Site Security Guidelines for the U.S Chemical Industry*, American Chemistry Council, Washington DC, 2001.
3. Thomas R. Krause. (1996). The *Behaviour – based safety process: Managing involvement for an injury-Free Culture*. (second edition). John Wiley & Sons.
4. Kaila, H.L. (2010). Behaviour based safety in organisations – a practical guide. IK International, New Delhi.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15–1803 DISASTER MANAGEMENT

Course Objectives:

To provide a theoretical and practical knowledge base to students on emergency planning and response.

Course Outcomes:

On completion of this course the student will demonstrate good theoretical and practical knowledge of

1. Emergencies and controls, with examples of industrial disasters and their consequences.
2. Emergency planning and preparedness.
3. Important regulatory and codal provisions on HSE
4. Natural disasters, mitigation of their effects, rescue, relief and rehabilitation.

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 emergency 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. Emergency preparedness at local level – Awareness and preparedness for emergencies at local level (APELL) – The process and its partners.

Module III

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, Emergency Planning in Seveso II directive – elements of emergency planning in IS : 18001 – Hazardous Materials / Spills Emergencies – contingency plans for road transportation of hazardous chemicals – contingency plans for oil spills in marine environment.

Module IV

Natural Hazards – potentially hazardous natural phenomena – earthquakes – landslides – flooding – cyclones – hazards in arid and semi-arid areas – nature of the hazard – hazard management activities – disaster mitigation – natural hazard prediction – emergency preparedness – disaster, rescue and relief – post disaster rehabilitation and reconstruction – education and training activities – vulnerable elements to be considered in the development planning for natural hazard management – applications of remote sensing and GIS in disaster management.

References:

1. ILO, Geneva (1988). *Major Hazard Control – a Practical Manual*.
2. UNEP, Paris (1998). *APELL – A Process for responding to technological accidents - A Handbook*. Industry & Environment Office, UNEP.
3. National Safety Council, USA (2009). *Accident Prevention Manual for Business and Industry, Vol. I (13th ed)*
4. International Maritime Organisation (2011). *Oil spill Response: The National Contingency Plan*. Institute of Petroleum, London.
5. Petak, W. J. & Atkisson, A. A. (1982). *Natural Hazard Risk Assessment and Public Policy : Anticipating the Unexpected*. Springer-Verlag, New York
6. Rao, U. R. (1996). *Space Technology for Sustainable Development (1st ed)*. Tata-McGraw Hill

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 - 1804 E1 TOTAL QUALITY MANAGEMENT

Course Objectives:
To learn basics of total quality management.

Course Outcomes:
On successful completion of the course the student will have
1. Knowledge of dimensions of quality, costs of quality, basic concepts of TQM and quality statements
2. Knowledge of the seven principles of TQM
3. Knowledge of SQC, the seven tools of quality, concept six sigma and seven management tools
4. Knowledge of TQM tools-benchmarking, QFD, TPM and quality systems like ISO 9000

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

TEXT BOOK

Dale H.Besterfiled, et al., "*Total Quality Management*", Pearson Education, Inc. 2003. (Indian reprint 2004).

REFERENCES

1. James R.Evans & William M.Lidsay, "*The Management and Control of Quality*", (5th Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
2. Narayana V. and Sreenivasan, N.S. "*Quality Management – Concepts and Tasks*", New Age International 1996.
3. Zeiri. "*Total Quality Management for Engineers*", Wood Head Publishers, 1991.

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 – 1804 E2 INTRODUCTORY DESIGN OF STRUCTURES

Course Objectives:

To develop among the students basic understanding and design of concrete and steel structures

Course Outcomes:

On successful completion of this course the students will be able to carry out basic designs of of

1. Reinforced concrete slender beams
2. One-way reinforced concrete slabs and short and long columns
3. Different types of joints in steel structures
4. 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. (2009). Design of Concrete Structures (14th ed.). McGraw Hill Companies Inc.
2. Pillai, S. U. & Menon, D. (2009). *Reinforced Concrete Design (3rd ed.)*. Tata McGraw Hill, New Delhi.
3. Varghese, P. C. (2002). *Limit State Design of Reinforced Concrete (2nd ed.)*. Prentice Hall India, New Delhi.
4. Bhavikatti, S. S. (2012). *Design of Steel Structures (3rd ed.)*. I. K. International Publishing House.
5. Ramamrutham, S. (2004). *Design of Steel Structures*. Dhanpat Rai Publications.
6. Chandra, R. (2014). *Design of Steel Structures (11th ed.)*. Standard Book House, Delhi.
7. Dayaratnam (1996). *Design of Steel Structures*. S. Chand

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15 1804 E3 COMPUTATIONAL FLUID DYNAMICS

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

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15–1804 E4 INTELLECTUAL PROPERTY RIGHTS

Course Objectives:

To make the students fully aware of the importance of intellectual property and the rights attached to it. This will encourage innovation, patenting and entrepreneurship which are the desirable outcome of the programme.

Course Outcomes:

On completion of this course the students will be well conversant with the legal provisions on:

1. International Conventions on intellectual properties
2. Patent
3. Copyright
4. Trademarks, designs, confidential information and semiconductor IC layout-design

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. & Agitha, T. G. (2014). *Principles of Intellectual Property (2nd ed.)*. Eastern Book Co.
3. Nair, A. K. (2013). *Lecture Notes on IPR*. Aparna Publications, Thiruvananthapuram.
4. Deborah, E. Bouchoux (2012). *Intellectual Property: Trade marks, copyrights, patents and trade secrets (3rd ed.)*. Cengage.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II

Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15- 1804 E5 STATISTICAL METHODS FOR ENGINEERS

Course Objectives: The objective of this course is to learn and understand the statistical methods and their applications in engineering.

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

1. Understand the effects of estimation theory
2. Get acquainted with tests of hypotheses concerning mean, variance and proportion
3. Apply the correlation and regression techniques in engineering problems
4. Recognise the importance of multivariate analysis

Module 1
Estimation Theory - Estimators: Unbiasedness, Consistency, Efficiency and Sufficiency –Maximum Likelihood Estimation –Method of moments

Module 2
Testing of Hypothesis - Tests based on Normal, t, X^2 and F distributions for testing of means, variance and proportions –Analysis of r x c tables – Goodness of fit.

Module 3
Correlation and Regression - Multiple and Partial Correlation –Method of Least Squares –Plane of Regression –Properties of Residuals –Coefficient of multiple correlation –Coefficient of partial correlation –Multiple correlation with total and partial correlations –Regression and Partial correlations in terms of lower order co-efficient.

Module 4
Design of Experiments and Multivariate Analysis - Analysis of variance – One-way and two-way classifications –Completely randomized design – Randomized block design – Latin square design.
Random vectors and Matrices –Mean vectors and Covariance matrices – Multivariate Normal density and its properties –Principal components: Population principal components –Principal components from standardized variables.

References:

1. Gupta.S.C., and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, Eleventh Edition, 2002
2. J.E. Freund, Mathematical Statistical”, 5th Edition, Prentice Hall of India, 2001.
3. Jay L.Devore, “Probability and statistics for Engineering and the Sciences”, 5th Edition, Thomson and Duxbury, Singapore, 2002
4. Murray.R. SpiegelandLarry J.Stephens, “Schaum’s Outlines-Statistics”, Third Edition, Tata McGraw Hill, 2000

5. R.A.Johnson and C.B.Gupta, “Miller & Freund’s Probability and Statistics for Engineers”, 7th Edition , Pearson Education, Asia, 2007
6. Richard A.Johnson and Dean W.Wichern, “Applied Multivariate Statistical Analysis”, 6th edition, Pearson Education, Asia, 2007

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV, V with sub sections (a), (b) ---- (10 marks each with options to answer either IV or V) from Module II
Question nos. VI, VII with sub sections (a), (b) ---- (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII, IX with sub sections (a), (b) ---- (10 marks each with options to answer either VIII or IX) from Module IV

SE15-18L1: SEMINAR

Course Objectives:
To encourage and motivate the students to read and collect recent and relevant information from their area of interest confined to the relevant discipline from technical publications including peer reviewed journals, conferences, books, project reports, etc., prepare a report based on a central theme and present it before a peer audience.

Course Outcomes:
On completion of this course the student will be able to:
1. Identify and familiarize with some of the good publications and journals in their field of study.
2. Acquaint oneself with preparation of independent reports, name them based on a central theme and write abstracts, main body, conclusions and reference identifying their intended meaning and style.
3. Understand effective use of tools of presentation, generate confidence in presenting a report before an audience and improve their skills in the same.
4. Develop skills like 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 and 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 report and presentation shall be evaluated by a team of internal experts comprising of 3 teachers based on style of presentation, technical content, adequacy of references, depth of knowledge and overall quality of the seminar report.

SE 15-18L2: PROJECT

Course Objectives:
To enable students to apply any piece of theory and experiments which they have learned to a specific problem related to industry / research which is identified with the help of a guide and solve it.

Course Outcomes:
On completion of this course the student will be able to:
1. Realize 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. Initiate a habit of proper report writing with all of its major components, proper style of writing and preparation of a distinct abstract and carved out conclusions.
3. Conceive the pros and cons of working in a team and the wonderful results which could evolve through team-work.
4. Present and defend 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 will carry out the assessment based on at least one interim review and a final review just before the submission of the project report.

The final evaluation of the project shall include the following.
Presentation of the work
Oral examination
Demonstration of the project against design specifications
Quality and content of the project report.

Guidelines for evaluation:

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** marks

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.

SE15-18L3: COMPREHENSIVE VIVA - VOCE

Course Objectives:
To test the student's learning and understanding of the theory and applications of the various concepts taught during the entire course of their programme and to prepare the students to face interviews in both the academic and industrial sectors.

Course Outcomes:
The student will be able to:
1. Refresh all the subjects covered during the programme
2. Gain good knowledge of theory and practice
3. Develop oral communication skills and positive attitude
4. Face technical interviews with confidence

Each student is required to appear for a comprehensive viva-voce examination at the end of the complete course work. The examination panel shall comprise of a minimum of one internal examiner and one external examiner, both appointed by the University. The examiners shall evaluate the students in terms of their conceptual grasp of the entire course of study and practical/analysis skills in the field.