

POST GRADUATE DIPLOMA (INDUSTRIAL SAFETY)

Introduction:

Safety at the work place and in factories is a very important aspect. Neglecting safety can lead to potential injury or even death of a worker. Very often due to neglect, equipment get damaged and hazards like fire cause colossal loss to the concerned factory. As such, there can never be two opinion about the importance of safety in industries. Safety of men and material should be the first and foremost point at every work place. With rapid modernization and enhanced development activity, more and more factories are coming up. The government has also made it mandatory for every industry to follow stringent norms on all safety issues. This has made available numerous opportunities for employment in this field.

Objective:

To develop highly qualified professional manpower the basic requirement lies on systematic quality based coaching and training in Advanced Science and Technologies. Therefore, the course is designed to train and provide expert human resource to safety management and expected to bring direct benefits to industry and society. The course is based on following objectives:

- To develop an expert manpower to handle the complex industrial environment.
- To give knowledge about occupational health, industrial hygiene, accidental prevention techniques to the students.
- To make the student aware about safety auditing and management systems, pollution prevention techniques etc.
- To train the students about risk assessment and management.
- It will produce well trained, qualified and expert manpower for the Industrial sector.
- Better placement opportunity for PG diploma students.
- Course will be useful for in-service people from the industry.
- More interaction between Institution and Industry

Outcome:

After completion of the course the students will learn the concept of Safety, Health and Environmental Management, Safety in Industries, Hazard Identification, Assessment and Control Techniques and Safety Engineering. They will be able to implement industry oriented data.

Study Scheme
PG Diploma (INDUSTRIAL SAFETY)
2020 Admission Batch Onwards
SEMESTER-1

Subject Code	Course Title	Subject Type(Theory /Practical)	Hours per week		Marks Distribution		Total Marks	Credits
			L	P	Internal	External		
PGPE-101	Safety, Health and Environmental Management	Theory	3	0	40	60	100	3
PGPE-102	Safety Engineering I	Theory	3	0	40	60	100	3
PGPE-103	Appraisal, Analysis, Inspection and Quality Control	Theory	3	0	40	60	100	3
PGEPE-xxx	Elective I	Theory	3	0	40	60	100	3
LPGPE-101	Laboratory-I	Practical	0	4	30	20	50	2
PGPRPE-101	Project-1*	Practical	0	8	60	40	100	8
Total			12	12	250	300	550	22

*Project -1 will be based on Industrial oriented problem.

**Each student has to undergo four (4) week industrial training at the end of 1st semester. The evaluation and the credit of the industrial training will be included in 2nd semester. The training will be purely Industry-oriented only.

SEMESTER-2

Subject Code	Course Title	Subject Type (Theory/Practical)	Hours per week		Marks Distribution		Total Marks	Credits
			L	P	Internal	External		
PGPE-104	Safety, Health and Environmental Legislations	Theory	3	0	40	60	100	3
PGPE-105	Safety Engineering II	Theory	3	0	40	60	100	3
PGPE-106	Industrial Hygiene and Occupational health	Theory	3	0	40	60	100	3
PGEPE-xxx	Elective II	Theory	3	0	40	60	100	3
LPGPE-102	Laboratory-II	Practical	0	4	30	20	50	2
PGPRPE-102	Project-2*	Practical	0	8	120	80	200	8
PGTR-101	Industrial Training**	Practical	0	0	60	40	100	4
Total			12	12	370	380	750	26

*Project -2 will be based on Industrial oriented problem.

**The marks of industrial training undergone at the end of 1st semester will be included in the 2nd semester. The evaluation scheme the industrial training shall be as under:-

Internal: out of 60 marks, 20 marks will be given on the basis of industrial visit made by the student during 1st semester. The students have to visit the selected industry five times in the semester in such a way that in each month he/she has to make at least one visit in the same industry. The student has to maintain a diary a day to day for recording the report of each visit. 40 marks shall be given on the basis of his/her performance.

External: External examiner should be essential from the industry and will evaluate the student on the basis of oral viva for 40 marks.

Elective I :

PGEPE-101 Safety in Manufacturing Industries

PGEPE-102 Safety in Construction Industries

ElectiveII :

PGEPE-103 Safety in Chemical Industry

SUBJECT CODE: PGPE-101**SUBJECT NAME: SAFETY, HEALTH AND ENVIRONMENTAL MANAGEMENT**

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 1	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 20%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

UNIT- I: Introduction

Management: Concept, Definition, Nature and Importance; Evolution of Management Thoughts; Role and Functions of a Manager; Elements and Functions of Management. Management Principles: Managerial Role, Authority, Responsibility & Power; Span of Management; Delegation and Decentralization of Authority; General Principles of Management.

Industrial Safety: History of Safety Movement in India and Abroad; “The Accident Problem”. Nature & Size; Need for Safety; Legal, Humanitarian, Economic and Social Consideration. Safety Management: Role of Management in Industrial Safety; Safety Management – Principles & Practices.

UNIT-II:Principles of Accident Prevention

Definitions: Accident, Injury, Hazard, Unsafe Acts, Unsafe Conditions, Dangerous Occurrences etc. Accident Prevention: Theories of Accident Occurrences; Principles of Accident Prevention; Models of Accident Prevention.

UNIT-III: Planning for Safety

Planning: Definition, Purpose, Nature, Scope and Procedure; Range of Planning, Variety/Forms of Plans, Strategic Planning and Process of Implementation; Management by Objectives and its Role in Safety Policy Formulation and Effective Planning for Safety.

UNIT-IV: Organising for Safety

Organizing: Definition, Need, Nature and Principles. Organization for Safety: Organization Structure and Safety Department. Safety Officer: Role, Responsibilities, Authority, Power and qualifications/Attributes. Safety Committee: Structure and Functions; Line & Staff functions in Safety Department.

UNIT-V: Directing for Safety

Direction: Definition, Process, Principles & Techniques. Leadership: Role, Functions & Attributes of a leader; Leadership Styles and Safety Management. Communication: Fundamentals, Importance, Process, Types & Channels; Five Essential Rules for communication; Two-way Communication; Barriers and Break-downs in Communication; Communication with Management, Employees & Union; Communication and Group Dynamics.

UNIT-VI:Safety Education and Training

Training for Safety: Assessment of Needs, Design & Development of Training Programme; Training Methods and Strategies; Training of Manager, Supervisors & Workers; Evaluation and Review of Training Programmes. Training Programme: In-Plant Training Programmes; Out of Plant Training Programmes; Seminars, Programmes for New Workers: Job Instructions Vs Safety Instructions.

UNIT-VII: Employee Participation in Safety

Employee Participation: Purpose, Nature, Scope and Methods; Safety committee and Union participation. Trade Unions: History of Trade Unions in India; Role of Trade Unions in Safety and Health; Collective Bargaining and safety. Safety Promotion & Publicity: Safety Suggestion Schemes, Safety Competitions, Safety incentive Schemes; Audio Visual Publicity and other Promotional Methods.

UNIT-VIII:OrganisationalBehaviour and Safety

Human factors: Understanding Human Factors; Role of Human Factors in accidents Causation and their Management. Human Behavior: Individual Difference; Behavior as Function of Self and Situation; Perception of Danger and Acceptance of Risks; Knowledge and Responsibility vis-à-vis Safety Performance. Theories of Motivation and their Application to Safety; Role of Management, Supervisors and Safety Department in Motivation. Frustration, Conflicts and their Management; Attitudes towards safety and Health. Understanding Perception, Illusions and their Management.

UNIT-IX: Financial Aspects of Safety

Cost of Accident: Financial Costs-direct and indirect; Social Costs of Accidents; Compilation Procedure for financial Costs; Cost Data; Quality and its Limitations-Budgeting.

UNIT-X:Major Accident Hazards Control

Major Accident Hazards: Introduction, Types and Consequences of Major Industrial Hazards; Role of Management, Local Authorities and Public. Emergency Planning: Definition, Scope and Objectives; Identification and assessment of hazards; Risk Analysis, on-site Emergency Planning, Off-site Emergency Planning.

UNIT-XI:Safety Management Information and Control System

Sources of Information on Safety, Health, and Accidents; Compilation and Processing, of Information; Analysis and Use of Modern Methods; Storing and Retrieval of MIS for SHE; Status and Future Scope of Computer Utilization in SHE Services in Industries

Text/References:

1. K.U. Mistry, “Fundamentals of Industrial Safety and Health”,SiddharthPrakashan, 2008.
2. S. C. Sharma, “Safety, Occupational Health and Environmental Management in Construction”, Khanna publishers 2013.
3. R. K. Jain, “Industrial Safety, Health and Environment Management Systems”, Khanna publishers, 2000.
4. Nicholas P. Cheremisinoff Madelyn L. Graffia, “Environmental and Health and Safety Management”, William Andrew, 1995.
5. Institution of Occupational Safety and Health, “Risk assessment- A Practical Guide”, United Kingdom, 1993.
6. John A. Reader , Edward Rowland and Bob Day, “Health, Safety and Environment Legislation: A Pocket Guide”, Royal Society of Chemistry; Poc edition,2003.

SUBJECT CODE: PGPE-102

SUBJECT NAME: SAFETY ENGINEERING I

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 1	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 10%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

UNIT-I: Safeguarding of Machines

Statutory Provisions Related to Safeguarding of Machinery and Working on/near Unguarded Machinery; Principles of Machine Guarding; Ergonomics of Machine Guarding; Type of Guards; Guarding of Different Types of Machinery – Wood Working, Paper, Rubber and

Printing Machinery ; Selection, Maintenance and Repair of Guards; Incidental Safety Devices and Methods.

UNIT-II: Manual Handling and Storage of Materials

Basic Principle of Correct Lifting and Handling of Materials; Avoidance of Excessive Muscular Efforts; Maximum Loads that may be Carried; Lifting and Carrying of Objects of Different Shapes, Size and Weight; safe Use of Accessories for Manual Handling; Storage of Materials; Ergonomics of Manual Handling and Storage.

UNIT-III: Mechanical Handling of Materials

Lifting machinery: Safety Aspects in Design and Construction; Testing, Use and Care, Signaling, Inspection and Maintenance, operation, Inspection and Maintenance of Power Trucks and Tractors, Lifts and Hoists, Lifting Tackles, and Loose Gears, Conveyors, Safety Features, Safe Working Load, Destructive and Non Destructive Testing, Inspection and Maintenance of Lifting Tackles, The Component Persons, Duties and Responsibilities Under the Various Safety Legislations.

UNIT –IV: Working at Heights

High Incidence of Serious Accidents in Working at Heights; Types of operations, Safety Features Associated with Design, Construction and use of Stairways, Rungs, Ramps, Gangways, Floors, Ladders of Different types, Scaffolds of Different types including Boatswain’s Chair and Safety Belts, Working on Roofs, Other Safety requirements while working at Heights, Prevention of Fall of Persons at Floor Level, Potential Tripping and Slipping Hazards.

UNIT –V: Hand Tools and Portable Power Tools

Main Cause of Tools Accidents, Control of Tool Accidents, Centralized Tool Control, Purchase, Storage and Supply of Tools, Inspection, Maintenance and repair of Tools, Detectable Causes of Tools Failures, Tempering, Safe Ending and Dressing of Certain Tools, Handles of Tools, Safe use of various Types of Hand Tools Used for Metal Cutting, Wood Cutting, Miscellaneous Cutting Work, Material Handling; and other Hand Tools such as Torsion Tools, Shock Tools, Non-sparking Tools, Portable Power Tools and their Selection, Inspection, Maintenance, Repair and Safe Use.

UNIT –VI: Safety at Work Place

Concept of Workplace and its Design, Improving Safety and Productivity through Work Place Design Control Measures, Technical and Engineering Control Measures, Control Measures against Human Error, Preventive Maintenance, Role of Preventive Maintenance in Safety and Health, Standards and Code of Practices for Plant and Equipment, Standardization and its benefits, Purchasing Policy.

Text/References:

1. A.K. Gupta, “Industrial Safety and Environment”, Laxmi Publications Pvt Limited, 2008.
2. K.U. Mistry, “Fundamentals of Industrial Safety and Health”, SiddharthPrakashan, 2008.
3. L M Deshmukh, “Industrial Safety Management”, McGraw-Hill Education LLC, 2005.
4. C.RayAsfahl, “Industrial Safety and Health Management”, Prentice-Hall, 1990.

SUBJECT CODE: PGPE-103**SUBJECT NAME: APPRAISAL, ANALYSIS, INSPECTION AND QUALITY CONTROL**

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 1	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 10%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

UNIT-I: Plant and Equipment Safety Appraisal & Control Techniques

Objectives, Plant safety observation, Plant Safety Inspections, Safety sampling, Safety Surveys, Job Safety Analysis, Safety Analysis, Safety Inventory System, Product Safety, Permit to Work systems Safety Tag Systems, Loss Control, Damage Control & System Safety.

UNIT-II: Hazard Identification Techniques

Hazard analysis: Inductive and Deductive FMEA, CMA, Fault Tree Analysis, Examples of each. Risk Analysis Techniques, HAZAN, Hazard and Operability (HAZOP) Study, Safety Audit, Evaluating risks in Chemical Process.

UNIT-III: Accident Investigation Reporting and Analysis

Purpose Identification of Key Factors and the Causes, Writing Reports and Report Forms, Corrective Action, Standard Classification of Factors Associated with Accident, Methods of Collecting and Tabulating Data, Keeping the Records.

UNIT-IV: Measurement and Control of Performance

Lost Time Accident, Disabling Injury, Accidents Reportable under the Factories Act and E.S.I Act, Frequency Rate, Severity Rate, Incidence Rate per 1000 workers and man days. Lost, Temporary Disablement and Permanent Disablement, Partial and Total Disablement, Time Charges Scheduled in Workmen's Compensation Act and the Indian Standard.

Text/References:

1. Geoff Wells, "Hazard Identification and Risk Assessment", The Institution of Chemical Engineers, 2004.
2. Frank Crawley, "A Guide to Hazard Identification Methods", Elsevier, 2020
3. K.U. Mistry, "Fundamentals of Industrial Safety and Health", SiddharthPrakashan, 2008.

SUBJECT CODE: LPGPE-101**SUBJECT NAME: LABORATORY-I**

Programme: PG Diploma	L: 0 T: 0 P: 4
Semester: 1	Teaching Hours: 48
Theory/Practical: Practical	Credits: 2
Internal Marks: 30	Percentage of Numerical/Design/Programming Problems: 10%
External Marks: 20	Duration of End Semester Exam(ESE): 3hr
Total Marks: 50	Status: Compulsory

1. Assessment and analysis of Heat Stress in Working Environment at various locations.
2. Detection of Carbon Monoxide, No_{xx} Hydrogen Sulphide, Ammonia, Aromatic Hydrocarbons, SO₂.

3. Dust concentration detection test by various methods.
4. Sampling and Analysis of Ammonia.
5. Estimation of Hydrogen Sulphide in Air.
6. Detection of Chlorine in industrial Environment.
7. Sampling and Analysis of SO₂ using Colorimetric Method.
8. Physical Fitness Test using treadmill.
9. Calibration of Rota meter by Soap Bubble Meter.
10. Estimation of Work Capacity Fatigue and Rest Allowances and Physiological test for physical Work Capacity.
11. Anthropometry Practical Measurement of the human body; Dimension, Its treatment and application.
12. Measurement of reaction time (RT) and Critical Flicker Fusion test for the assessment of reaction time and level of fatigue.

SUBJECT CODE: PGPE-104

SUBJECT NAME: SAFETY HEALTH AND ENVIRONMENTAL LEGISLATION

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 2	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 10%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

UNIT-I:History of Safety Legislation in India

ILO Convention and Recommendation In Providing Safety, Health And Welfare To Workers.

UNIT-II:Factories Act 1948 and The Factories Rules

Case Laws Under The Factories Act.

UNIT-III:Employees Welfare And Legislation

Workman Compensation Act And Rules. ESI Act And Rules. Contract Labour Act. Employees Liability Act. Common Law And Product Safety.

UNIT-IV: Other Important Legislations

Indian Boilers Act And Regulations. Indian Electricity Act And Rules. Indian Explosives Act And Rules. Petroleum Act And Rules. Gas Cylinders Rules. Calcium Carbide Rules. Radiation Protection Act And Regulations. Hazardous Material Transportation Rules, Static And Mobile Pressure Vessels Rules. The Dock Workers (Safety, Health & Welfare) Act & Regulations. Statutory Provisions On Building And Other Construction Works. The Water (Control Of Pollution) Act And Rules. The Air (Control Of Pollution) Act And Rules, Marine Pollution Statutes, Motor Vehicles Act, The Insecticides Act And Rules. The Poison Act And Rules. The Dangerous Drug Act, The Drug And Cosmetic Act, Environmental Protection Act 1 And Rules There Under. Public Liability Insurance Act 1991. Building And Other Construction Workers Act 1996 And Rules 1998.

Text/References:

1. K.U. Mistry, "Fundamentals of Industrial Safety and Health", SiddharthPrakashan, 2008.
2. S. C. Sharma, "Safety, Occupational Health and Environmental Management in Construction", Khanna publishers 2013.
3. R. K. Jain, "Industrial Safety, Health and Environment Management Systems", Khanna publishers, 2000.

4. Nicholas P. Cheremisinoff Madelyn L. Graffia, “Environmental and Health and Safety Management”, William Andrew, 1995.
5. Institution of Occupational Safety and Health, “Risk assessment- A Practical Guide”, United Kingdom, 1993.
6. John A. Reader , Edward Rowland and Bob Day, “Health, Safety and Environment Legislation: A Pocket Guide”, Royal Society of Chemistry; Poc edition,2003.

SUBJECT CODE: PGPE-105
SUBJECT NAME: SAFETY ENGINEERING II

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 2	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 00%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

UNIT- I: Plant Design and Housekeeping

Plant layout and design: Safety and good Housekeeping, Need for Planning and follow-up, Typical Accidents due to Poor Housekeeping, Disposal of Scrap and other Trade wastes. Prevention of Spillage, Marking of Gangways and other locations, Use of color as an Aid for good Housekeeping, Clean-up Campaigns, Cleaning Methods, employee Assignment, Inspections and Check-list, Result of good Housekeeping.

UNIT- II: Industrial Lighting

Purpose of Lighting, Advantages of good Illumination, Lighting and Safety, Lighting and the Work, Sources and Types of Artificial Lighting, Principles of good Illumination, Recommended minimum standards of Illumination, Design of Lighting Installation, Maintenance, Lighting and Color.

UNIT- III: Ventilation and Heat Control

Purpose of Ventilation, Thermal Environment and its Measurement, Physiology of Heat Regulation, Thermal Comfort, Indices of Heat Stress, Thermal limits for Comfort, Efficiency and Freedom from Health Risk, Natural Ventilation, Mechanical Ventilation, Air Conditioning, Process Ventilation, Control of Heat Exposures, Control at Source, Installation, Local Exhaust Ventilation, Control of Radiant Heat, Dilution Ventilation, Local Relief.

UNIT- IV: Electrical Hazards

Danger from Electricity, Safe Limits of Amperages, Voltages, Safe Distance from Lines, Capacity and Protection of Conductors, Joints and Connections, Means of Cutting off Power, Overload And Short Circuit Protection, Earth fault Protection, earth Insulation and Continuity Tests, Protection against Over-voltage. Hazards arising out of ‘Borrowed’ Neutrals. Other precautions: Portable Electrical Apparatus, Flame Proof Electrical Equipments, Precautions in their Selection, Installation, Maintenance and Use, Control of Hazards Due to Static Electricity.

UNIT- V: Noise and Vibration

Noise: Effect of Noise on Man, Measurement and Evaluation of Noise, Vibration Damping, Noise Isolation, Noise Absorption, Silencers, Practical aspects of control of Noise, Case Studies on impact of Noise from Compressors and Generators. Vibration: Effects, Measurement and Control.

UNIT- VI: Fire and Explosion

Statutory Provisions regarding Fire Safety, Factors contributing towards fire, Chemistry of fire, Classification of Fires, Common Causes of Industrial Fires, Determination of Fire Load, Fire Resistance of Building Materials, Design of Building Plant, Exits, etc. for Fire Safety, Prevention of Fire, Portable Extinguishers, Water Systems, Carbon-dioxide Systems, Foam Extinguisher, Dry Chemical Extinguishing System, Industrial fire Detection and Alarms, Sprinkle Systems, Special Precautionary Measures in Handling/Processing flammable Liquids, Gases, Vapors, Mists and Dusts, BLEVE (Boiling Liquid Expanding Vapor Explosion), Fighting Fires involving Pesticides, Emergency Action Plan, EAC or Hazchem Code.

Text/References:

1. A.K. Gupta, "Industrial Safety and Environment", Laxmi Publications Pvt Limited, 2008.
2. K.U. Mistry, "Fundamentals of Industrial Safety and Health", Siddharth Prakashan, 2008.
3. L M Deshmukh, "Industrial Safety Management", McGraw-Hill Education LLC, 2005.
4. C.Ray Asfahl, "Industrial Safety and Health Management", Prentice-Hall, 1990.

SUBJECT CODE: PGPE-106

SUBJECT NAME: INDUSTRIAL HYGIENE AND OCCUPATIONAL HEALTH

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 1	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 10%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

UNIT-I: Industrial Hygiene

Definition of Industrial Hygiene, Control Methods, Routes Of Entry To Human System, Recognition, Evaluation And Control Of Hazards. Chemical Hazards: Introduction To Chemical Hazards, Dangerous Properties Of Chemicals, Dust, Gases, Fumes, Mists, Vapours, And Smoke, Exposure, Evaluation And Air Sampling Work Environment Monitoring Personal Monitoring. The Concept of Threshold Limit Values, Biological Sampling, Dose Response Relationship, Bio-Chemical Action of Toxic Substances. Physical Hazards: Noise, Vibration, Improper Illumination, Thermal Radiation. X-Rays, Ultra Violet Radiation, Ionizing And Non-Ionizing Radiations. Permissible Industrial Exposure Limits. Effects Of Exposures. Preventive and Control Measures.

UNIT-II: Work Physiology

Classification Of Work Load, Work Capacity And Man-Job Alignment, Fatigue And Rest Allowances, Physiological Tests In Occupational Health Assessment. Ergonomics: Fitting The Task To Man, Application Of Ergonomics In Safety And Health Management, Fitness Criteria For Work, Diet And Exercise For Work, Understanding Physiological Stress And Its Management And Rehabilitation.

UNIT-III: Occupational Health

Common Occupational Diseases, Occupation Involving Risks Of Contracting These Diseases, Mode Of Causation Of The Diseases And Its Effects, Diagnostic Methods, Methods Of Prevention, Compensation For Occupational Diseases, Evaluation Of Injuries, Industrial Medical Services In An Industrial Establishment And Its Function. Occupational Diseases Of The Lungs, Occupational Dermatitis, Occupational Cancer, Pre-Employment And Periodic Medical Examination Of The Workers, Medical Surveillance For Control Of Occupational Diseases,

Health Records, Fundamentals Of First-Aid, Burns, Fractures, Suffocation, Toxic Ingestion – Bleeding Wounds, Artificial Respiratory Techniques, Bandaging.

UNIT-IV: Personal Protective Equipment

Non-respiratory personal protective equipment: Head Protection, Ear Protection, Face And Eye Protection, Hand Protection, Feet Protection, Body Protection, Supply, Use, Care And Maintenance Of Personal Protective Equipment, Requirements Under The Factories Act And Rules. Respiratory personal protective equipment: Classification Of Hazards, Classification Of Respiratory Personal Protective Devices, Selection Of Respirators, Instructions And Hints In The Use Of Breathing Apparatus, Supply, Use, Care And Maintenance Of Breathing Apparatus, Training In The Use Of Breathing Apparatus.

Text/References:

1. C.RayAsfahl, “Industrial Safety and Health Management”, Prentice-Hall,1990.
2. K.U. Mistry, “Fundamentals of Industrial Safety and Health”,SiddharthPrakashan, 2008.
3. S. C. Sharma, “Safety, Occupational Health and Environmental Management in Construction”, Khanna publishers 2013.
4. R. K. Jain, “Industrial Safety, Health and Environment Management Systems”, Khanna publishers, 2000.
5. Nicholas P. Cheremisinoff Madelyn L. Graffia, “Environmental and Health and Safety Management”, William Andrew, 1995.
6. John A. Reader , Edward Rowland and Bob Day, “Health, Safety and Environment Legislation: A Pocket Guide”, Royal Society of Chemistry; Poc edition,2003.

SUBJECT CODE: LPGPE-102

SUBJECT NAME: LABORATORY-II

Programme: PG Diploma	L: 0 T: 0 P: 4
Semester: 2	Teaching Hours: 48
Theory/Practical: Practical	Credits: 2
Internal Marks: 30	Percentage of Numerical/Design/Programming Problems: 10%
External Marks: 20	Duration of End Semester Exam(ESE): 3hr
Total Marks: 50	Status: Compulsory

1. Measurement of number of air changes in a room by Velometer.
2. Measurement of illumination level by Photo Meter.
3. Measurement of Static Charge in workspace.
4. Earthing continuity test using Meggar or Voltmeter.
5. Measurement of Sound levels at various locations.
6. Measurement of Insulation Resistance.
7. Continuity test for Electrical Circuits using continuity meter.

SUBJECT CODE: PGEPE-101
SUBJECT NAME: SAFETY IN MANUFACTURING INDUSTRY

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 2	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 00%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Elective

UNIT- I: Introduction

Introduction to Various Hot and Cold Processes In Engineering Industry Including Manufacture Of Various Grades Of Steel.

UNIT- II: Hot Working Of Metals

Flow Sheet For Foundry Operations Including Use Of Different Types Of Furnaces In Each Of The Operation. Health Hazards And Safe Methods Of Preparation In The Above. Forging Operation: Different Forging Operation Hazards Inclusive Of Heat Radiation. Preventive Maintenance For Forging Machines – Hammers, Safe Work Practice In Forging Operations. Operation In Hot And Cold Rolling Mills, Safe Work Practices In The Above.

UNIT- III: Cold Working

Safety In The Use Of 1. Power Presses (All Types), 2. Shearing, 3. Bending, 4. Rolling, 5. Drawing, 6. Turning, 7. Boring, 8. Milling, 9. Planning, 10. Grinding Inclusive Of The Need For Selection And Care Of Tools, Preventive Maintenance And Periodic Checks For Safe Operation. Associated Hazards And Their Prevention.

UNIT- IV: Other Operations

Safety Precaution In The 1. Welding, 2. Cutting, 3. Soldering Operations. Selection, Care And Maintenance Of Associated Equipment, Instruments, Safety In Finishing Operations Like 1. Cleaning, 2. Polishing, 3. Buffing And Related Hazards. Maintenance Of These Machines And Selection Of Equipment With Reference To Safety.

UNIT- V:Heat Treatment

Various Heat Treatment Methods. Safety In Handling, Storage. Responsibility Of Treatment Medium. Disposal Of Effluents Thereof. Health Precautions, Elimination And Prevention Of Long Time Exposure To Hazardous Fumes.

UNIT- VI:Safety Statutes

Relevant provision in the factories act and rules pertaining to hot working and cold working.

UNIT- VII: Health and Welfare

Occupational Hazards, Occupational Diseases, Personal Protective Equipment, Health and Welfare Measures, First-aid facilities and other Appropriate Measures, Hospitals, Clinics, Special precautions for specific work environments.

Text/References:

K.U. Mistry, “Fundamentals of Industrial Safety and Health”,SiddharthPrakashan, 2008.

SUBJECT CODE: PGEPE-102
SUBJECT NAME: SAFETY IN CONSTRUCTION INDUSTRY

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 2	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 00%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Elective

UNIT- I: Meaning of Safety in Construction

Basic philosophy, Peculiarities and parameters governing the safety in construction, Health and structural soundness, Accident and hazards their causes and effects.

UNIT- II: Safety in Construction Operations

Underground Works: Excavation, drilling and blasting, trenching, strutting, tunneling, piling and safety in using and operating machinery and equipment relating to the above components. Above Ground works: Scaffolding, centering, frame work, ladders concreting wall and floor openings, staircases and railings, structural steel work including welding, cutting, erection, etc. and safety in use and operation of related machinery and equipment. Under water operations: River draining, well sinking, caissons, under water concreting, cofferdams and special operations connected with irrigation works, safety in use and operation of related machinery and equipment. Movement of materials and personnel's: Heavy/long items, Railway wagons, motor trucks, vehicles, Hazardous materials etc. Special works: High rise buildings, bridges, roads, railways, asphaltting, pneumatic caissons, electrical installations and lifts.

UNIT- III: Safety in Demolition Operations

Planning and permit, precautions prior to demolition, protection of the public, precautions during demolition, Sequence of demolition operations from safety point.

UNIT- IV: Safety with regard to Storage, Stocking and Handling of Construction Material
Hazards, III-Effects and Safety Measures with Respect to Materials such as Cement, Limes Aggregates, Fly Ash, Timber, Steel, Glass, Paints, Varnishes and Petroleum Products.

UNIT- V: Safety Planning and Accident Prevention

Policy statement, safety budget, organization, training, implementation, rewards and penalties.

UNIT- VI: Health and Welfare

Occupational hazards; Occupational diseases; Personal protective equipments; Health and welfare measures; first – aid facilities and other appropriate measures; Hospital, Clinics, Special precautions for specific environments.

UNIT- VII: Statutory Obligations

Various statutory provisions for regulation of employment and condition of work in construction industry, IS and NB codes, Local by-laws, Accident investigation and reporting, Monitoring safety performance, Treatment of injuries and rehabilitation.

Text/References:

1. K.U. Mistry, "Fundamentals of Industrial Safety and Health", SiddharthPrakashan, 2008.

SUBJECT CODE: PGEPE-103
SUBJECT NAME: SAFETY IN CHEMICAL INDUSTRY

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 2	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 00%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Elective

UNIT- I

Safety In Chemical Industry, U.N. And Other Classification For Chemicals, Use Of Material Safety Data Sheets, Receiving, Storing And Handling Chemicals, Safety In Handling Of LPG Ammonia, Chlorine Etc. Compatibility Considerations, Transportation Of Chemicals, Various Modes, Precautions, Fulfillment Of Statutory Needs For Transporting Hazardous/Toxic/Flammable/Explosive Cargo By All Modes. Transfer Of Chemicals By Pipelines, Color Coding; Identification Of Contents. Precautions In Breaking Pipelines. Safe Entry Procedures To Confined Spaces Including Reaction Vessels. Start-Up And Shut-Down Procedures. Draw Up Of Maintenance Schedule For Safe Operation.

UNIT- II

Instrumentation for Safe Plant Operations. Work Permit Application, Adoption And Enforcement, Precaution In The Processes And Operations Involving Explosives, Flammable, Dust, Gases, Vapours. Vapour Cloud Formations and Combating. Runaway Reactions, Control, Precaution and Prevention. Introduction To Safety In Chemical Plants Using Chemicals And Resulting In Health Disorders Which Are Notified E.g. Fertilizer, Insecticides, Pesticides, Chloral-Alkali, Explosives, Polymer Plants, Toxic Release In Them And Engineering Controls, Sampling Technique For Toxic And Flammable Substances.

UNIT- III:

Assessment Of Dow Index, Risk Analysis, Dispersion Modeling, Probability Criteria, HAZOP, HAZAN, Pressure Vessels Fired And Unfired. Vessel Statutes, Steam Limes, Instruments Limiting Factors. Toxic Releases, Fire And Explosions, Emergency Planning, On Site And Off Site Emergency Plans. Emergency Preparedness, Rehearsal And Exercise, Criteria For Siting And Layout Of Chemical Plant.

UNIT- IV: Electrical Hazards

Inspection Techniques For Plants, Reaction Vessels, Checklists For Routine Checks, Checklist For Specific Maintenance And Breakdown. Asserting Reliability Of Vessels, NDT, Test Checks. Corrosion: Location And Causes, Prevention And Inspection. Criteria For The Plant To Be MAH Units. Relevant Provision Of Factories Act And Rules, Indian Explosives Act And Rules, Petroleum Act And Rules, Gas Cylinder Rules, Calcium Carbide Rules, Hazardous Material Transportation Rules, Environmental Protection Rules.

UNIT- V:

Occupational Hazards, Occupational Diseases, Personal Protective Equipment, Health And Welfare Measures, First Aid Facilities And Other Appropriate Measures. Hospitals, Clinics Special Precautions For Specific Work.

Text/References:

1. A.K. Gupta, "Industrial Safety and Environment", Laxmi Publications Pvt Limited, 2008.
2. K.U. Mistry, "Fundamentals of Industrial Safety and Health", SiddharthPrakashan, 2008.
3. L M Deshmukh, "Industrial Safety Management", McGraw-Hill Education LLC, 2005.

4. C.RayAsfahl, “Industrial Safety and Health Management”, Prentice-Hall,1990.

SUBJECT CODE: PGEPE-104

SUBJECT NAME: INDUSTRIAL ERGONOMICS

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 2	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 00%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Elective

UNIT- I

Introduction to Industrial Engineering and productivity, measurement of productivity. Introduction to work study, methods study principles and motion economy, design cycle, filming techniques and micro motion analysis, recording techniques, introduction to work measurement, time study, performance allowances, work sampling, predetermined motion systems, job evaluation and merit ration, wage incentive plans, methods time measurement.

UNIT- II

Introduction to ergonomics, man/machine/environment systems concept, development of ergonomics. Design approach: A new design, modification of existing design, assessment of a design, limitations of man & machine with respect to each other, Posture – standing at work, seated at work, work station heights and seat geometry. Human anthropometry and its use in work place layout.

UNIT- III:

Controls: Hand controls and foot controls, location of controls and work place envelope, recommendation about hand and foot push buttons, rotary selector switches, hand wheels, cranks, levers etc. instruments and displays.

UNIT- IV:

Work Load: Static and dynamic muscular load, human motor activity, metabolism, physical work load, repetitive and inspection work, measurement of physical work load, mental work load and its measurement, work duration and work pauses, principles of motion economy.

UNIT- V:

Climates: (a) Heat Humidity – Body heat balance, effective temperature scales, zones of discomfort, effect of heat on body and work performance. (b) Vibrations: Technology, response of body to low frequency vibrations, vibrations and discomfort, effect on health of worker, high frequency vibrations, effect of high frequency vibrations, methods of reducing vibrations. (c) Noise: Terminology, physiological effects of noise, annoyance of noise, speed interference, hearing loss, temporary and permanent threshold shift, effect of noise on performance, reduction of noise, personal noise protection.

Text/References:

1. Methods Engineering Study Krick, E.V
2. Work Study and Ergonomics Shan, H.S Dhanpat Rai & Sons 1992
3. Introduction to Ergonomics Bridger Tata McGraw Hill 1995
4. Work Study Khanna,O.P Dhanpat Rai & Sons 1995
5. Sound, Noise and Vibration Control Lyle, F. Yerges Van Nostrand 1978

POST GRADUATE DIPLOMA (PROJECT MANAGEMENT)

Introduction:

Today, it is widely recognized that there is a positive correlation between project employee training and certification in project management on the one hand, and project performance on the other. This positive correlation has been reinforced by paradigm shifts in globalization, advances in technology, the emergence of large and complex projects, focus on integration, innovative practices and networking. In today's dynamic business environment, it is imperative that organizations manage their projects efficiently and effectively. The programme primarily aims to help participants in understanding the globally recognized Framework for Project Management. Take up Accountability, Strategizing, Visualization, Planning, Scheduling, Monitoring and grow to higher level of decision making.

Objective:

To develop highly qualified professional manpower the basic requirement lies on systematic quality based coaching and training in Advanced Science and Technologies. Therefore, the course is designed to train and provide expert human resource to project management and expected to bring direct benefits to industry and society. The course is based on following objectives:

- To develop an expert manpower to handle the complex industrial environment.
- To give knowledge about Foundations of Project Management, Productivity Management Project Governance to the students.
- To make the student aware about Operations Management and Business Research Methodology etc.
- To train the students about project management.
- It will produce well trained, qualified and expert manpower for the Industrial sector.
- Better placement opportunity for PG diploma students.
- Course will be useful for in-service people from the industry.
- More interaction between Institution and Industry

Outcome:

Qualified project managers are in high demand in today's workplace in both large and small organizations. It opens opportunities in a wide range of industries like construction, automotive, information technology, pharmaceutical, telecommunications, oil, gas and petrochemical, finance, government and all project based organizations.

Study Scheme
PG Diploma (Project Management)
2020 Admission Batch Onwards
SEMESTER-1

Subject Code	Course Title	Subject Type (Theory/Practical)	Hours per week		Marks Distribution		Total Marks	Credits
			L	P	Internal	External		
PGPE-201	Foundations of Project Management	Theory	3	0	40	60	100	3
PGPE-202	Productivity Management	Theory	3	0	40	60	100	3
PGPE-203	Advance Operations Research	Theory	3	0	40	60	100	3
LPGPE-201	Laboratory-I #	Practical	0	4	30	20	50	2
LPGPE-202	Laboratory-II #	Practical	0	4	30	20	50	2
PGPRPE-201	Project-1*	Practical	0	8	60	40	100	8
Total			9	16	240	260	500	21

***Project -1 will be based on Industrial oriented problem.**

****Each student has to undergo four (4) week industrial training at the end of 1st semester. The evaluation and the credit of the industrial training will be included in 2nd semester. The training will be purely Industry-oriented only.**

#The Students shall complete Laboratory-I and Laboratory-II, on the practical problem or industry related topic based on any subject which is offered in the first semester.

SEMESTER-2

Subject Code	Course Title	Subject Type (Theory/Practical)	Hours per week		Marks Distribution		Total Marks	Credits
			L	P	Internal	External		
PGPE-204	Operations Management	Theory	3	0	40	60	100	3
PGPE-205	Business Research Methodology	Theory	3	0	40	60	100	3
PGPE-206	Project Governance	Theory	3	0	40	60	100	3
LPGPE-203	Laboratory-III #	Practical	0	4	30	20	50	2
LPGPE-204	Laboratory-IV #	Practical	0	4	30	20	50	2
PGPRPE-202	Project-2*	Practical	0	8	120	80	200	8
PGTR-201	Industrial Training**	Practical	0	0	60	40	100	4
Total			9	16	360	340	700	25

***Project -2 will be based on Industrial oriented problem.**

****The marks of industrial training undergone at the end of 1st semester will be included in the 2nd semester. The evaluation scheme the industrial training shall be as under:-**

Internal: out of 60 marks, 20 marks will be given on the basis of industrial visit made by the student during 1st semester. The students have to visit the selected industry five times in the semester in such a way that in each month he/she has to make at least one visit in the same industry. The student has to maintain a diary a day to day for recording the report of each visit. 40 marks shall be given on the basis of his/her performance.

External: External examiner should be essential from the industry and will evaluate the student on the basis of oral viva for 40 marks.

#The Students shall complete Laboratory-III and Laboratory-IV, on the practical problem or industry related topic based on any subject which is offered in the second semester.

SUBJECT CODE: PGPE-201**SUBJECT NAME: FOUNDATIONS OF PROJECT MANAGEMENT**

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 1	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 20%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

Unit 1: Introduction

Concept of a project, types of project, project life cycle phase, project development, project identification and selection, feasibility study.

Unit 2: Project Management

Functions, comparison with traditional management, forms for project management in industry and service sector.

Unit 3: Project Planning

Work Breakdown structure, project execution planning, contract planning. Work planning and organization planning, matrix organization, task force organization And totally project based organization systems and procedure planning.

Unit 4: Project Scheduling and Monitoring

Gantt Charts, Network Scheduling, PERT and CPM, Worked examples of PERT and CPM. Line of Balanced and Pace (Performance and Cost Evaluation) techniques.

Unit 5: Project Control

Project control process, performance analysis, internal and external project control, approaches to project control, control problems.

Text/References:

7. S. Choudhary, "Project Management", Tata Mc Graw Hill, 1999.
8. Nicholas, "Managing Business and Engineering Projects", Prentice Hall, 2000.
9. Prasanna Chandra "Project Preparation, Appraisal, Budgeting and Implementation", Tata McGraw Hill, 1995.

SUBJECT CODE: PGPE -202**SUBJECT NAME: PRODUCTIVITY MANAGEMENT**

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 1	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 20%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

Unit 1: Introduction

Definition of Productivity, Productivity and performance, production, benefit cycle, Industrial productivity, scope of productivity management, factors affecting productivity, different approaches to productivity.

Unit 2: Productivity Measurement

Need of productivity measurement, productivity measurement approaches, total & partial productivity, productivity measurement models and their comparison, productivity measurement parameters, productivity measurement indices, work study and productivity.

Unit 3: Productivity Planning

Causes for productivity changes, productivity models, applications of different planning models, productivity planning executives and their responsibilities.

Unit 4: Productivity Evaluation

Productivity evaluation, productivity evaluation models, evaluation tree model, successive, time period models, applications of different evaluation models, role of evaluating executives and their responsibilities.

Unit 5: Productivity Improvement

Causes of poor productivity, remedies of poor productivity, methods to improve productivity, design of productivity improvement programs.

Unit 6 Dynamic Programming of Productivity Problems

Static and dynamic causes of lower productivity, optimization of productivity.

Text Books:

1. Hassan M.Z.P., "Productivity Models", A&N Printing, Chicago, 1975.
2. Goodwin H.F., "Improvement in Productivity", Wiley, New York, 1982.
3. PremVrat, "Productivity Management", Narosa Publishing House, New Delhi, 1998.

SUBJECT CODE: PGPE -203

SUBJECT NAME: ADVANCE OPERATIONS RESEARCH

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 1	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 60%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

Unit 1: Introduction

Definition, characteristics, objectives and necessity, scope of operation research. History of operation research, Various Applications in different fields of Engineering.

Unit 2: Linear Programming

Introduction to linear programming, formulation of linear programming problems, graphical solution, the Theory of simplex solution, alternative optimal solution, unbounded solutions, infeasible solutions, simplex algorithm & method, Method of Penalties, Two Phase Method, Duality & Sensitivity Analysis, limitations of linear programming, revised simplex method

Unit 3: Transportation & Assignment Model

Definition of transportation model, formulation and solution methods, and degeneracy in transportation problems. Traveling salesman model, Assignment model, comparison with transportation model, formulation and solution methods, and their industrial applications

Unit 4: Queuing Models

Application of queuing models, characteristics of queuing models, single channel queuing theory, solution to single channel with poisson arrivals and exponential service infinite population model, limited and unlimited service, Queuing with parallel channels with limited and unlimited service. Bulk input, bulk service, priority queue discipline, queues in series, Industrial applications of queuing theory, Queues Models

Unit 5: Dynamic programming

Dynamic Optimization Models, Dynamic programming, principles of optimality, characteristics of dynamic programming problem, deterministic programming models for solution of investment problem, allocation problem, production scheduling and equipment replacement problem, probabilistic dynamic programming.

Unit 6: Decision Theory

Decision-making environments: Decision-making under certainty, uncertainty and risk situations; Uses of Decision tree,

Unit 7: Game Theory

Game Theory: Concept of game; Two-person zero-sum game; Pure and Mixed Strategy Games; Saddle Point; Odds Method; Dominance Method and Graphical Method for solving Mixed Strategy Game -Sequencing Problem: Johnsons Algorithm for n Jobs and Two machines, n Jobs and Three Machines, Two jobs and m Machines Problems., Brown’s algorithm.

Unit 8 Network Analysis

Work breakdown structure, network logic, critical path, CPM and PERT, slack and floats. Resources Leveling & Time cost trade off

Text Books:

1. P.K. Gupta and D.S.Hira, "Operations Research “, S. Chand and company
2. A.H. Taha, “Operation Research”, Macmillan Publishing Company
3. Operation research by Manohr Mahajan (Dhanpat Rai& Co. Publisher)

SUBJECT CODE: PGPE -204

SUBJECT NAME: OPERATIONS MANAGEMENT

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 2	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 20%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

Unit 1: Operations Management (OM)

Introduction, History and decisions of Operations Management, Production functions.

Unit 2: Work and Job design

Work design (Techniques-Work study and Method Study), Job Design (Design, Environmental and Organizational factors, Behavioral dimensions of job design, Socio-technical approach to job design).

Unit 3: Facilities planning

Importance of Facilities Planning, Product and Process selection, Facilities Location, facilities layout and materials handling.

Unit 4: Capacity planning

Capacity Planning (Introduction, Measurement of Capacity Planning, Capacity Utilization and Efficiency, Estimate Capacity Requirements, Estimating Future Capacity Needs, Factors Influencing Effective Capacity).

Unit 5: Production Planning and Control (PPC)

Introduction and Need of Production Planning and Control, Objectives, Phases and Functions of Production Planning and Control, parameters for PPC.

Unit 6: Maintenance Management

Terotechnology, Objectives of Maintenance, Types of Maintenance Systems, Total Productive Maintenance.

Unit 7: Quality assurance

Quality, Quality Management, Quality Assurance v/s Quality Control, Quality Assurance Systems, Components of Quality Assurance, quality circles formation and procedure.

Unit 8: Material Management

Purchase system and purchase principles, Inventory Management, Stores management, Standardization, Codification and variety reduction, Waste management.

Text Books:

1. Chunawala Patel, “Production and Operation Management”, Himalya Publishers., 1995.
2. Bhagde, S.D, “Production and Materials Management”, U.S.G Publishers, 1995.
3. Plossl, G.W& Wight, O.W., “Production and Inventory Control”, Prentice Hall, 1967.

SUBJECT CODE: PGPE -205**SUBJECT NAME: BUSINESS RESEARCH METHODOLOGY**

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 2	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 20%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

Unit 1:

Research- Concept , Classification ; Steps of Research Process ; Research Design – Definition, Features , Merits , Limitations , Applications of Exploratory , Descriptive and Causal Research, Research Objectives & Hypothesis Formulation.

Unit 2:

Primary & Secondary data classification , Qualitative research – Focus Group, Interviews and Projective Techniques; Types of survey & Observation methods ; Types of variables and classification of Experimentation Designs

Unit 3:

Primary Scales, Comparative and Non- Comparative Scales (Likert, Semantic), Concept of Reliability and Validity, Types of Questionnaire Design; Sampling Design – sample size determination, types of non-probability and probability sampling design.

Unit 4:

Basics of data analysis – frequency distribution, cross tabulation; Application of hypothesis testing – chi-square, t test, F test. Application of regression analysis; Format and types of Report Writing.

Text Books:

1. Naresh K Malhotra, “Marketing Research – An applied Orientation”, Pearson Publication, 2000.
2. Research Methodology, “Research Methodology”, Wishwa Prakashan, 2001.
3. Ranjit Kumar, “Research Methodology”, Oxford Press, 1999.

SUBJECT CODE: PGPE -206**SUBJECT NAME: PROJECT GOVERNANCE**

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 2	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 00%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

Unit-I: Project Governance, Corporate and Project Management Governance

Governance, Risk and Scope, Strategic Risk Management Process, Scope Management and Associated Challenges, Accountability, Disclosure and Transparency, Roles and Responsibilities, Risk Management, Decision-Making, Ethics, Performance and Effectiveness.

Unit-II: Governance of Project Management

Portfolio Direction, Project Sponsorship, Project Management Effectiveness and Efficiency, Disclosure and Reporting, Project Management Governance Framework

Unit-III: Introduction to the Role of the Board and Corporate Governance

Forms of Business Ownership; Separation of Ownership and Control: Principal-Agent Dilemma; History, Definition, Concept, Principles of Corporate Governance; Strategy

formulation and vision mission concepts; Benefits of Good Corporate Governance; Systems of Corporate Governance. The Theoretical Framework and Worldwide Developments; The International Corporate Governance Framework;

Unit-IV: Practical Tools for Monitoring, Strategic Guidance and Managerial Oversight

The International Perspective on ownership and rights and responsibilities of share ownership; Shareholder Representatives: Non-Executive and Independent Directors; What Is Shareholder Activism? Activism by Individual, Large, and Institutional Shareholders; Potential Roadblocks to Effective Shareholder Activism.

Unit-V: The Role of Board of Directors

When to Create a Board; Why Boards Are So Important; Understanding the Difference Between the Board and Management; Board Size, Composition, and Evaluation; The Role and Authority of the Board, The role of the board in management; The Agency problem; Strategy formation; Competitiveness; Board relationships; Role of the board in determining CEO compensation; Leadership; Directors' knowledge of the business

Unit-VI: The Role of the Board in Transparency and Disclosure

Reading and understanding the financial statements of a company; Defining Disclosure and Transparency; Effective Tools for Disclosure; Information Flows and Clear Communication Channels; Understand the significance of accounting and auditing for governance; Appreciate importance of timely and accurate disclosure; How much disclosure is adequate disclosure?; Role of the board in Shareholders protection through disclosure and transparency.

Unit-VII: Corporate Social Responsibility

A Changing World for Companies: Demanding stakeholders; The Stakeholder View of the Firm; The Concept of Corporate Social Responsibility; International Aspects of Corporate Social Responsibility; The Criticism of Corporate Social Responsibility.

Unit-VIII: International Corporate Governance & Environment: Implementing the OECD Corporate governance standards in different jurisdictions, including the United States, European Union countries and emerging countries. Corruption and impact on cost of capital. Access to finance. Regulations and agency costs. Does self-regulation work? Review and Conclusion.

Text Books:

1. Monks, R. A. G., & Minow, N., "*Corporate governance*", Wiley-Blackwell. 2011.
2. G. N. Bajpai, "*The Essential Book of Corporate Governance*", Sage Publications India Pvt Ltd, 2016.
3. A. C. Fernando & E. K. Satheesh, "*Corporate Governance: Principles, Policies and Practices*", Pearson, 2018.
4. Jayati Sarkar, "*Corporate Governance in India*", SAGE India, 2012.

POST GRADUATE DIPLOMA

(ADVANCED SMART MANUFACTURING)

Introduction:

In last one decade Advanced Smart Manufacturing has become popular with the rise in quantity and quality of computer systems. Since more automated tools are being used in manufacturing units it is necessary to model/ simulate and analyze all machines, tooling and input materials to optimize the manufacturing process. The P.G Diploma in Advanced Smart Manufacturing is in-line with the integrated approach to manufacturing which is centered on computer system. This P.G Diploma Advanced Smart Manufacturing course has been especially designed to full-fill goals of computer-integrated manufacturing, flexible manufacturing, lean manufacturing, and design for manufacturability.

Objective:

To develop highly qualified professional manpower the basic requirement lies on systematic quality based coaching and training in Advanced Science and Technologies. Therefore, the course is designed to train and provide expert human resource to smart manufacturing and expected to bring direct benefits to industry and society. The course is based on following objectives:

- To develop an expert manpower to handle the complex industrial environment.
- To give knowledge about Foundations of computer-integrated manufacturing, flexible manufacturing, lean manufacturing, and design for manufacturability
- To make the student aware about Mechatronics and Additive Manufacturing of Metals and Non-metals etc.
- To train the students about smart manufacturing.
- It will produce well trained, qualified and expert manpower for the Industrial sector.
- Better placement opportunity for PG diploma students.
- Course will be useful for in-service people from the industry.
- More interaction between Institution and Industry.

Outcome:

After the completion of course students has plenty of options to choose from in terms of his/her career. One can choose to as Manufacturing engineer, Assistant controller, Project manager, Quality Inspector, Professor etc.

Study Scheme
PG Diploma (Advanced Smart Manufacturing.)
2020 Admission Batch Onwards
SEMESTER-1

Subject Code	Course Title	Subject Type (Theory/Practical)	Hours per week		Marks Distribution		Total Marks	Credits
			L	P	Internal	External		
PGPE-301	Advanced Engineering Materials	Theory	3	0	40	60	100	3
PGPE-302	Materials Characterisation	Theory	3	0	40	60	100	3
PGPE-303	Mechatronics	Theory	3	0	40	60	100	3
LPGPE-301	Laboratory-I #	Practical	0	4	30	20	50	2
LPGPE-302	Laboratory-II #	Practical	0	4	30	20	50	2
PGPRPE-301	Project-1*	Practical	0	8	60	40	100	8
Total			9	16	240	260	500	21

*Project -1 will be based on Industrial oriented problem.

**Each student has to undergo four (4) week industrial training at the end of 1st semester. The evaluation and the credit of the industrial training will be included in 2nd semester. The training will be purely Industry-oriented only.

#The Students shall complete Laboratory-I and Laboratory-II, on the practical problem or industry related topic based on any subject which is offered in the first semester.

SEMESTER-2

Subject Code	Course Title	Subject Type (Theory/Practical)	Hours per week		Marks Distribution		Total Marks	Credits
			L	P	Internal	External		
PGPE-304	Industrial Internet of Things	Theory	3	0	40	60	100	3
PGPE-305	Additive Manufacturing Processes and Applications	Theory	3	0	40	60	100	3
PGPE-306	Industrial Robotics	Theory	3	0	40	60	100	3
LPGPE-303	Laboratory-III #	Practical	0	4	30	20	50	2
LPGPE-304	Laboratory-IV #	Practical	0	4	30	20	50	2
PGPRPE-302	Project-2*	Practical	0	8	120	80	200	8
PGTR-301	Industrial Training**	Practical	0	0	60	40	100	4
Total			9	16	360	340	700	25

*Project -2 will be based on Industrial oriented problem.

**The marks of industrial training undergone at the end of 1st semester will be included in the 2nd semester. The evaluation scheme the industrial training shall be as under:-

Internal: out of 60 marks, 20 marks will be given on the basis of industrial visit made by the student during 1st semester. The students have to visit the selected industry five times in the semester in such a way that in each month he/she has to make at least one visit in the same industry. The student has to maintain a diary a day to day for recording the report of each visit. 40 marks shall be given on the basis of his/her performance.

External: External examiner should be essential from the industry and will evaluate the student on the basis of oral viva for 40 marks.

#The Students shall complete Laboratory-III and Laboratory-IV, on the practical problem or industry related topic based on any subject which is offered in the second semester.

SUBJECT CODE: PGPE-301**SUBJECT NAME: ADVANCED ENGINEERING MATERIALS**

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 1	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 20%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

Unit 1: Classification and Selection of Materials

Classification of materials, Properties required in Engineering materials, Criteria of selection of materials, Requirements / needs of advance materials.

Unit 2: Non Metallic Materials

Classification of non-metallic materials, Rubber: Properties, processing and applications, Plastics: Thermosetting and Thermoplastics, Applications and properties, Ceramics: Properties and applications, Adhesives: Properties and applications, Optical fibers: Properties and applications, Composites: Properties and applications.

Unit 3: High Strength Materials

Methods of strengthening of alloys, Materials available for high strength applications, Properties required for high strength materials, Applications of high strength materials.

Unit 4: Low & High Temperature Materials

Properties required for low temperature applications, Materials available for low temperature applications, Requirements of materials for high temperature applications, Materials available for high temperature applications, Applications of low and high temperature materials.

Unit 5: Nanomaterial's

Definition, Types of nanomaterial's including carbon nanotubes and nano-composites, Physical and mechanical properties, Applications of nanomaterial's.

Unit 6: Smart materials

Overview of smart materials, Piezoelectric Ceramics, Piezo-polymers, Magnetostrictive Materials, Electro active Polymers, Shape Memory Alloys, Electro and Magneto Rheological Fluids, Modelling of smart materials, introduction to composite smart materials, Mechanics of smart composite materials, Smart sensors based on high bandwidth low strain smart materials, Low-bandwidth high strain smart actuators, Micro-electro mechanical Smart Systems, Intelligent devices based on smart materials, Applications of Smart Actuators: Active and Hybrid Vibration Control, Active Shape Control, Distributed Sensing and Control of Smart Beams

Text/References:

1. Van Vlack, "Elements of Material Science and Engineering", Pearson Education India, 2002.
2. V.D. Kodgire, "Material science and Metallurgy", Everest Publishing House, 2011.
3. D. R. Askeland and P. P. Phule, "The Science and Engineering of Materials", Thomson Publication, 2002.
4. Gulaev, "Physical Metallurgy-II", MIR Publication, 2000.
5. Gregory Tirp, "Nano Technology", Springer, 2005.
6. Brian Culshaw, "Smart Structures and Materials", Artech House, 2000.
7. Gauenzi, P., "Smart Structures", Wiley, 2009
8. Cady, W. G., "Piezoelectricity", Dover Publication, 2001.

SUBJECT CODE: PGPE -302
SUBJECT NAME: MATERIALS CHARACTERISATION

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 1	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 20%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

Unit 1

Introduction to materials and methods, Fundamentals of Materials Characterization, Basic operation, sample preparation and interpretation of data. Basic failure analysis of materials using different characterization equipment.

Unit 2

BET surface area analyzer, Atomic force Microscopy (AFM), Scanning Electron Microscopy (SEM); Transmission Electron Microscopy (TEM).

Unit 3

X-ray Diffraction (XRD); Small Angle X-ray Scattering (SAXS); High Power X-ray (Synchrotron).

Unit 4

UV-VIS Spectrophotometer; FT-IR Spectrophotometer; Micro-Raman Spectrometer, Electrical Impedance Spectroscopy (EIS), Electrical transport measurement.

Unit 5

Thermal Gravimetric Analysis (TGA), Differential thermal analysis (DTA), Differential scanning calorimetry (DSC) and Differential Mechanical Analysis (DMA).

Text/reference Books:

1. Y. Leng, "Materials Characterization: Introduction to Microscopic and Spectroscopic Methods", Wiley, 2008.
2. Sam Zhang, Ashok Kumar and Lin Li, "Materials Characterization Techniques", CRC Press, 2008.
3. John C. Vickerman, Ian Gilmore, "Surface Analysis: The Principal Techniques", John Wiley & Sons, Ltd, 2009.

SUBJECT CODE: PGPE -303
SUBJECT NAME: MECHATRONICS

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 1	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 20%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

Unit 1: Overview of Mechatronics

Historical perspective, Definition, Applications, Block diagram of Mechatronic system, Functions of Mechatronic Systems, Systems Engineering, Verification Vs Validation, Benefits of mechatronics in manufacturing.

Unit 2: Electrical and Electronic Systems

Electrical circuits and Kirchhoff's laws, Network Theorems and AC circuit Analysis, Transformers, Analog Devices, Signal Conditioning, Digital Electronics, Data Acquisition systems.

Unit 3: Modeling, Analysis and Control of Physical Systems

Basics of System Modeling: LTI and LTV systems, Need for modeling, Types of modeling, Steps in modeling, Building blocks of models, Modeling of one and two degrees of freedom systems, Modeling of Electro-mechanical systems, Mechanical Systems, Fluid systems, Thermal systems; Dynamic Responses, System Transfer Functions, State Space Analysis and System Properties, Stability Analysis using Root Locus Method, Stability Analysis using Bode Plots, PID Controllers (with and without Time Delay).

Unit 4: Sensors and Actuators

Static characteristics of sensors and actuators, Position, Displacement and Proximity Sensors, Force and torque sensors, Pressure sensors, Flow sensors, Temperature sensors, Acceleration sensors, Level sensors, Light sensors, Smart material sensors, Micro and Nano sensors, Selection criteria for sensors, Actuators: Electrical Actuators (Solenoids, Relays, Diodes, Thyristors, Triacs, BJT, FET, DC motor, Servo motor, BLDC motor, AC motor, Stepper motors), Hydraulic and Pneumatic actuators, Design of Hydraulic and Pneumatic circuits, Piezoelectric actuators, Shape memory alloys.

Unit 5: Microprocessors, Microcontrollers and Programmable Logic Controllers

Logic Concepts and Design, System Interfaces, Communication and Computer Networks, Fault Analysis in Mechatronic Systems, Synchronous and Asynchronous Sequential Systems, Architecture, Microcontrollers, Programmable Logic Controllers (PLCs): Architecture, Number Systems Basics of PLC Programming, Logics, Timers and Counters, Application on real time industrial automation systems.

Text/reference Books:

1. W. Bolton, "Mechatronics, Electronic control systems in mechanical and electrical engineering", Pearson Education, 5/e, 2011.
2. James J Allen, "Micro Electro Mechanical Systems Design", CRC Press Taylor & Francis group, 2005.
3. David G. Alcaiatore and Michel B. Histan, "Introduction to Mechatronics and Measuring Systems", Mc. Graw Hill Int. Edition, 3/e, 2006.
4. Craig K. C. and Stolfi, F. R., "Introduction to Mechatronic System Design with Applications", IEEE Educational Activities Department, 1994.
5. Robert H. Bishop, "The Mechatronics Handbook", CRC Press, 2/e, 2007.

SUBJECT CODE: PGPE -304

SUBJECT NAME: INDUSTRIAL INTERNET OF THINGS

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 2	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 20%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

Unit 1: Introduction

Introduction to IOT, What is IIOT? IOT Vs. IIOT, History of IIOT, Components of IIOT - Sensors, Interface, Networks, People & Process, Hype cycle, IOT Market, Trends & future Real life examples, Key terms – IOT Platform, Interfaces, API, clouds, Data Management Analytics, Mining & Manipulation; Role of IIOT in Manufacturing Processes Use of IIOT in plant maintenance practices, Sustainability through Business excellence tools Challenges & Benefits in implementing IIOT.

Unit 2: Architectures

Overview of IOT components ; Various Architectures of IOT and IIOT, Advantages & disadvantages, Industrial Internet - Reference Architecture; IIOT System components: Sensors,

Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN, WSN network design for IOT.

Unit 3:Sensor and Interfacing

Introduction to sensors, Transducers, Classification, Roles of sensors in IIOT , Various types of sensors , Design of sensors, sensor architecture, special requirements for IIOT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet , Current, M2M etc.

Unit 4:Protocols and Cloud

Need of protocols; Types of Protocols, Wi-Fi, Wi-Fi direct, Zigbee, Z wave, Bacnet, BLE, Modbus, SPI , I2C, IIOT protocols –COAP, MQTT,6lowpan, lwm2m, AMPQ IIOT cloud platforms : Overview of cots cloud platforms, predix, thingworks, azure etc. Data analytics, cloud services, Business models: Saas, Paas, Iaas.

Unit 5:Privacy, Security and Governance

Introduction to web security, Conventional web technology and relationship with IIOT, Vulnerabilities of IoT, Privacy, Security requirements, Threat analysis, Trust, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity, Non-repudiation and availability, Security model for IoT, Network security techniques Management aspects of cyber security.

Unit 6:IoT Analytics and Applications

IOT Analytics: Role of Analytics in IOT, Data visualization Techniques, Introduction to R Programming, Statistical Methods. Internet of Things Applications : Smart Metering, e-Health Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Plant Automation, Real life examples of IIOT in Manufacturing Sector.

Text/reference Books:

1. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118-47347-4, Willy Publications
2. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer.
3. Hakima Chaouchi, “ The Internet of Things Connecting Objects to the Web” ISBN : 978-1-84821-140-7, Willy Publications.
4. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key Applications and Protocols”, ISBN: 978-1-119-99435-0, 2 nd Edition, Willy Publications
5. Ovidiu & Peter, “Internet of Things- From Research and Innovation to Market Deployment”, River Publishers Series.

SUBJECT CODE: PGPE -305

SUBJECT NAME: ADDITIVE MANUFACTURING PROCESSES AND APPLICATIONS

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 2	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 10%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

Unit 1: Introduction to Additive Manufacturing

Introduction to AM, AM evolution, Distinction between AM & CNC machining, Advantages of AM.

Unit 2: AM process chain

Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build, removal and clean up, post processing.

Unit 3: Classification of AM processes

Liquid polymer system, discrete particle system, molten material systems, solid sheet system.

Unit 4: Design for AM

Motivation, DFMA concepts and objectives, AM unique capabilities, Exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers etc.

Unit 5: Guidelines for process selection

Introduction, selection methods for a part, challenges of selection, example system for preliminary selection, production planning and control.

Unit 6: AM Applications

Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Re-manufacturing. Application examples for Aerospace, defense, automobile, Bio-medical and general engineering industries.

Unit 7: Post processing of AM parts

Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques.

Unit 8: Additive Manufacturing of Metals and Non-metals

3D polymer printing, metal printing and bio printing, process parametric optimization, analysis of process, mechanical, morphological, thermal, rheological characterization for additively manufactured components.

Text/reference Books:

1. Chua Chee Kai, Leong Kah Fai, "Rapid Prototyping: Principles & Applications", World Scientific, 2003.
2. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
3. Ali K. Kamrani, Emand Abouel Nasr, "Rapid Prototyping: Theory & Practice", Springer, 2006.
4. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer, 2001

UBJECT CODE: PGPE -306

SUBJECT NAME: INDUSTRIAL ROBOTICS

Programme: PG Diploma	L: 3 T: 0 P: 0
Semester: 2	Teaching Hours: 36
Theory/Practical: Theory	Credits: 3
Internal Marks: 40	Percentage of Numerical/Design/Programming Problems: 00%
External Marks: 60	Duration of End Semester Exam(ESE): 3hr
Total Marks: 100	Status: Compulsory

Unit-I: Introduction

History of robots, Classification of robots, Present status and future trends. Basic components of robotic system. Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom. Mechanisms and transmission, End effectors, Grippers-different methods of gripping,

Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, Cam type gripper, Magnetic grippers, Vacuum grippers, Air operated grippers; Specifications of robot..

Unit-II: Drive systems and Sensors

Drive system- hydraulic, pneumatic and electric systems Sensors in robot – Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.

Unit-III: Kinematics and Dynamics of Robots

2D, 3D Transformation, Scaling, Rotation, Translation, Homogeneous coordinates, multiple transformation, Simple problems. Matrix representation, Forward and Reverse Kinematics Of Three Degree of Freedom, Homogeneous Transformations, Inverse kinematics of Robot, Robot Arm dynamics, D-H representation of robots, Basics of Trajectory Planning.

Unit-IV: Robot Control, Programming and Applications

Robot controls-Point to point control, Continuous path control, Intelligent robot, Control system for robot joint, Control actions, Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Adaptive control. Introduction to Robotic Programming, On-line and off-line programming, programming examples. Robot applications-Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting..

Text/reference Books:

1. Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, "Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012.
2. Craig. J. J. "Introduction to Robotics- mechanics and control", Addison- Wesley, 1999.
3. S.R. Deb, "Robotics Technology and flexible automation", Tata McGraw-Hill Education., 2009.
4. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, "Robotics Engineering an Integrated Approach", PHI Learning., 2009.
5. Francis N. Nagy, Andras Siegler, "Engineering foundation of Robotics", Prentice Hall Inc., 1987.
6. P.A. Janaki Raman, "Robotics and Image Processing an Introduction", Tata McGraw Hill Publishing Company Ltd., 1995.
7. Carl D. Crane and Joseph Duffy, "Kinematic Analysis of Robot manipulators", Cambridge University press, 2008.
8. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., "Robotics control, sensing, vision and intelligence", McGraw Hill Book co, 1987.
9. Ray Asfahl. C., "Robots and Manufacturing Automation", John Wiley & Sons Inc.,1985