

Environmental Technology (90)
5th Semester

Sl. No	Subject code	Name of the subject	T P C			MARKS				
						Theory		Practical		Total
						Cont. assess	Final exam.	Cont. assess	Final exam.	
1.	9051	Water & Waste Water Treatment	3	3	4	30	120	25	25	200
2.	9052	Health, Safety and Environment (HSE)	1	3	2	10	40	25	25	100
3.	9053	Environmental Microbiology	2	3	3	20	80	25	25	150
4.	6433	Structural Mechanics	3	3	4	30	120	25	25	200
5.	6454	Theory of Structure	3	3	4	30	120	25	25	200
6.	9054	Geographic Information System (GIS) and Remote Sensing	2	3	3	20	80	25	25	150
7.	5851	Book Keeping & Accounting	2	0	2	20	80	-	-	100
1		2 Total	16	18	22	160		150	150	1100

Environmental Technology (90)
6th Semester

Sl. No	Subject code	Name of the subject	T P C			MARKS				
						Theory		Practical		Total
						Cont. assess	Final exam.	Cont. assess	Final exam.	
1.	9061	Water Supply & Sanitation Engineering	3	3	4	30	120	25	25	200
2.	9062	Instrumental Technique in Environmental Analysis	1	3	2	10	40	25	25	100
3.	6463	Design of Structure -1	3	3	4	30	120	25	25	200
4.	6471	Estimating & Costing-2	3	3	4	30	120	25	25	200
5.	6465	Construction Management	2	3	3	20	80	25	25	150
6.	6466	Transportation Engineering	2	3	3	20	80	25	25	150
7.	5852	Industrial Management	2	0	2	20	80	-	-	100
3		4 Total	16	18	22	160	640	150	150	1100

4-YEAR DIPLOMA-IN-ENGINEERING PROGRAM

Environmental Technology (90)

SYLLABUS
(COURSE STRUCTURE-2010)

FIFTH SEMESTER

9051

Water & Waste Water Treatment

	T	P	C
OBJECTIVES	3	3	4

The objective of this course is to teach students how to properly determine the design size of treatment units used in conventional and advanced water treatment plants to achieve a specified level of performance.

Specifically, the student will develop the following skills and be able to do the following:

- Understand the basic and cost-effective design principles of common water and wastewater treatment engineering systems.
- Choose the appropriate operating engineering processes for water and wastewater treatment.
- Develop the ability to apply basic understandings of physical, chemical, and biological phenomena to the successful design and operation of industrial water and wastewater treatment plants.
- Perform the experiment of waste water treatment.

SHORT DESCRIPTION

Drinking water, wastewater treatment process. Municipal water and wastewater treatment, pre-treatment, physical, chemical, biological treatment and advanced water treatment unit, Sludge treatment and disposal, Wastewater source, effects characteristics, and treatment process of municipal and various industries as pulp and paper mill, tannery, textile mill, fertilizer plant, sugar mill, pharmaceutical plant. Application of WTP and ETP in industries.

DETAIL DESCRIPTION

Theory:

1. Understand the Introduction of Water and Wastewater Treatment

- 1.1. Define: Wastewater, Sewage, Sewerage, Industrial wastewater/Effluent, raw water, soft water, Hard water.
- 1.2. State the objectives of water & wastewater treatment.
- 1.3. Mention the composition of wastewater / effluent.
- 1.4. Mention the composition of sewage.
- 1.5. Describe advantages & Disadvantages of hard water & soft water.

2. Understand the drinking water treatment

- 2.1. Define Portable water.
- 2.2. Mention the steps of drinking water treatment unit processes.
- 2.3. Draw the typical sequence of treatment for groundwater sources of excellent quality and with moderate concentration of Iron.
- 2.4. Draw the typical sequence of unit treatment processes for water abstracted from an upland storage reservoir and an upland river, both of good quality.

- 2.5. Draw the typical sequence of unit treatment processes for a low land river supply of moderate to poor quality.
- 3. Understand Municipal water and wastewater treatment**
 - 3.1. Define municipal water.
 - 3.2. Mention the sources of municipal water supply
 - 3.3. Describe the municipal water treatment with a diagram of water treatment plant.
 - 3.4. Describe the basic steps of a complete physical-chemical treatment facility for municipal wastewater with flow diagram.
 - 3.5. Describe the municipal surface water treatment plant with flow diagram.
- 4. Understand the advanced water treatment**
 - 4.1. Mention the advanced water treatment processes.
 - 4.2. Describe the Activated Carbon treatment.
 - 4.3. Describe the removal of Total Hardness from water.
 - 4.4. Describe the Iron & Manganese removal process in water treatment.
 - 4.5. Describe the Fluoride removal process in water treatment.
 - 4.6. Describe the Arsenic removal process in water treatment.
 - 4.7. Describe the Dissolve Organics and Inorganics removal process in wastewater treatment.
 - 4.8. Describe the desalinization process from water.
 - 4.9. Describe the demineralization process from water
- 5. Understand the pre-treatment of water and wastewater.**
 - 5.1. Define pretreatment.
 - 5.2. Describe pretreatment of wastewater.
 - 5.3. Draw the sketch of pretreatment of wastewater.
 - 5.4. Describe the significance of pre-treatment of industrial wastewater.
 - 5.5. List the pre-treatment technologies of Industries
 - 5.5.1. Food-processing dairies industries
 - 5.5.2. Textile industries
 - 5.5.3. Pharmaceutical industries
 - 5.5.4. chemical, fertilizer & ceramic industries
 - 5.5.5. Leather tanning and finishing industries
 - 5.5.6. Pulp & paper industries
- 6. Understand the physical treatment of wastewater.**
 - 6.1. List the Physical unit processes in wastewater treatment.
 - 6.2. Describe balancing and Screening of wastewater treatment.
 - 6.3. Describe Sedimentation and Flotation of wastewater treatment.
 - 6.4. Describe Hydrocyclone and Filtration of wastewater treatment.
 - 6.5. Describe Reverse osmosis of wastewater treatment.
 - 6.6. Describe membrane Bio reactor (MBR) of waste water treatment.
 - 6.7. Describe Ultrafiltration and Microfiltration of wastewater treatment.
 - 6.8. Describe Adsorption of wastewater treatment by Activated Carbon.
 - 6.9. Describe the process of pressure sand filtration (PSF), Dual media filtration(DMF), Multigrade filtration (MGF) & trickling filtration
- 7. Understand the Chemical treatment of wastewater.**

- 7.1. Define coagulation, flocculation, sedimentation.
- 7.2. List the chemical unit processes in wastewater treatment.
- 7.3. Describe Neutralization of wastewater treatment.
- 7.4. Describe coagulation, flocculation, sedimentation of wastewater treatment.
- 7.5. Describe Oxidation Reduction of wastewater treatment.
- 7.6. Describe the Electro coagulation rectifier (ECR) of waste water treatment.
- 7.7. Describe disinfection process of waste water
 - A. chlorination & de chlorination.
 - B. U.V disinfection
 - C. Ozone disinfection

8. Understand the Biological treatment of wastewater.

- 8.1. List the Biological unit processes in wastewater treatment.
- 8.2. Describe Activated sludge treatment of wastewater.
- 8.3. Describe diffused aeration process of waste water.
- 8.4. Describe the Moving bed bio reactor (MBBR) of waste water.
- 8.5. Describe rotating biological contractor (RBC).
- 8.6. Describe the Anaerobic digestion of wastewater treatment.
- 8.7. Describe the pathways of BOD removal in biological wastewater treatment.
- 8.8. Describe the advantages and disadvantages of physical-chemical and biological treatment in water and wastewater system.

9. Understand the odor & foam removal process in wastewater treatment.

- 9.1. List the compounds responsible for odour in waste water.
- 9.2. Mention the classification of deodorization process.
- 9.3. Describe the physical and chemical methods for deodorization of waste water.
- 9.4. Explain the biofiltration technique and list its applications in odour removal.
- 9.5. Describe the foam removal technique from waste water.

10. Understand the removal of colour from wastewater.

- 10.1. List the treatment technologies for colour removal from waste water.
- 10.2. Describe the sorption systems for colour removal from waste water.
- 10.3. Describe the precipitation systems for colour removal from waste water.
- 10.4. Describe the membrane systems for colour removal from waste water.
- 10.5. Describe the oxidation systems for colour removal from waste water.
- 10.6. Describe the innovation systems for colour removal from waste water.

11. Understand the sludge treatment and disposal.

- 11.1. Define sludge.
- 11.2. Objective of sludge treatment.
- 11.3. Mention the sequence of sludge treatment.
- 11.4. Describe the thickening of sludge.
- 11.5. Describe the stabilization of sludge.
- 11.6. Describe the de watering of sludge.
- 11.7. Describe the sludge treatment by filter press & centrifuge.
- 11.8. List the sludge disposal processes.

12. Understand the treatment processes of pulp and paper mill wastewater.

- 12.1. Mention the wastewater characteristics of pulp and paper mill.

- 12.2. Describe the treatment process of pulp and paper mill wastes with flow diagram.
- 12.3. Mention the standard limit of pulp & paper mills waste water as per DOE guide line.

13. Understand the treatment processes of tannery wastewater.

- 13.1. Mention the components of tannery waste.
- 13.2. Describe the effects of tannery wastes on environment
- 13.3. Describe the treatment process of tannery wastes with flow diagram.
- 13.4. Mention the standard limit of Tannery waste water as per DOE guide line.

14. Understand the treatment processes of wastewater from textile industry.

- 14.1. List the sources of wastes from textile industry.
- 14.2. Mention the wastewater characteristics of textile industry.
- 14.3. Describe the effects of textile industry wastes on environment.
- 14.4. Describe the treatment process of dyeing & printing industry waste with flow diagram.
- 14.5. Describe the treatment process of textile (washing) industry waste with flow diagram.

- 14.6. Mention the standard limit of textile industries waste water as per DOE guide line.

15. Understand the treatment processes of wastewater from fertilizer plant.

- 15.1. State the types of wastes generated from fertilizer plant.
- 15.2. Describe the effect of fertilizer plant wastes on environment.
- 15.3. Describe the treatment process of fertilizer plant wastes plant with flow diagram.
- 15.4. Mention the standard limit of fertilizer factory waste water as per DOE guide line.

16. Understand the treatment processes of sugar mill wastewater.

- 16.1. Mention the characteristics of sugar mill wastes.
- 16.2. Describe the treatment process of sugar mill waste.
- 16.3. Mention the standard limit of sugar mill waste water as per DOE guide line.

17. Understand the treatment processes of pharmaceutical plant wastewater.

- 17.1. Mention the wastewater characteristics of pharmaceutical industry.
- 17.2. Mention the characteristics of antibiotic wastes of pharmaceutical plant.
- 17.3. Describe the effects of antibiotic waste on environment.
- 17.4. Describe the treatment process of antibiotic waste of pharmaceutical plant with flow diagram.
- 17.5. Mention the characteristics of synthetic drug wastes of pharmaceutical plant.
- 17.6. Describe the effects of synthetic drug waste on environment.
- 17.7. Describe the treatment process of synthetic drug waste of pharmaceutical plant with flow diagram.
- 17.8. Mention the standard limit of pharmaceutical industries waste water as per DOE guide line.

18. Understand the Procedure of waste water treatment plant

- 18.1. Describe the procedure and flow diagram of ETP (Biochemical) in industry.
- 18.2. Describe the procedure and diagram of ETP (Chemical) in industry.
- 18.3. Describe the procedure and diagram of ETP (Biological) in industry.

18.4. Describe the procedure and diagram of waste water recycling.

PRACTICAL:

1. Draw the sketch of treatment process options commonly employed at both domestic and industrial wastewater treatment plants.
2. Draw the sketch of drinking water plant.
3. Draw the sketch of Arsenic removal plant.
4. Draw the sketch of Iron removal plant.
5. Draw a flow diagram for treatment of waste of a pulp and paper mill.
6. Draw a flow sheet for treatment of wastes from a pharmaceutical plant.
7. Draw the flow diagram of treatment process for sewage from septic tank.
8. Draw a flow diagram for treatment of dyeing & printing mill waste.
9. Draw a flow diagram for treatment of washing mill waste.
10. Draw a flow diagram for effluent treatment for a complex fertilizer plant
11. Draw a flow diagram for complete treatment of sugar mill waste.
12. Field visit (case study) of WTP of Bangladesh.
13. Field visit (case study) of ETP (Biochemical) of Textile and Pharmaceutical industry.
14. Field visit (case study) of ETP (Biological) of Textile and Pharmaceutical industry.
15. Field visit (case study) of ETP (Chemical) of Textile and Pharmaceutical industry.
16. Field visit (case study) of waste water recycling plant.

REFERENCE BOOKS:

1. Feroze Ahmed & Md. Mujibur Rahman; Water Supply and Sanitation.
2. N. F. Gray; Water Technology, An Introduction for Environmental Scientists and Engineers.
3. M. N. Rao and A. K. Datta; Waste Water Treatment.
4. A P Sincero and G A sincero (1999); Environmental Engineering.
5. Manahan, Stanley E; Environmental Chemistry.
6. Peavy, Rewe Technology lous (1985); Environmental Engineering.
7. Gerard Kiely; Environmental Engineering.

Health, Safety and Environment
9052

T P C
1 3 2

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.
- To be able to understand the HSE standards.

SHORT DESCRIPTION

General introduction, the safe use of machines and tools, the occupational health and hazards, the accident prevention techniques, the legislative measures related to health, safety and environment.

DETAIL DESCRIPTION

1. Understand the general introduction

- 1.1. Define environmental safety
- 1.2. Describe the significance of health, safety and environmental management
- 1.3. Define work station, hazard, risk, safety, accident, emergency, health, good practice, bad practice
- 1.4. Describe the accidents and work related ill health
- 1.5. Describe the causes of the accidents
- 1.6. Describe HSE management system
- 1.7. Describe the types of hazards
- 1.8. Describe steps of risk management

2. Understand the safe use of machines and tools

- 2.1. Describe safe use of hand tools
- 2.2. Describe machine guarding
- 2.3. Describe various type of working areas i.e. confined spaces, underground, heights, roofs, lifts and hoists etc.
- 2.4. Describe plant layout, design and safe distance
- 2.5. Describe ventilation and heat stress
- 2.6. Describe safety and good housekeeping.
- 2.7. Describe disposal of scrap and waste
- 2.8. Describe use of color as an aid of housekeeping
- 2.9. Describe cleaning methods
- 2.10. Describe recommended optimum standard of illumination
- 2.11. Describe standards for lighting and color
- 2.12. Describe activities related to vibrations
- 2.13. Describe practical aspects of control of noise

3. Understand the occupational health and hazards

- 3.1. Describe types and effects of radiation on human body
- 3.2. Describe control of radiation
- 3.3. Describe industrial hygiene
- 3.4. Describe accident related to electrical systems
- 3.5. Describe control of electrical systems hazards
- 3.6. Describe causes and classification of fire.

- 3.7. Describe detection procedure of fire.
- 3.8. Describe extinguishing methods
- 3.9. Describe fire fighting installations with and without fire.

4. Understand the accident prevention techniques

- 4.1. Define: incident, injury, dangerous occurrences, unsafe acts, unsafe conditions, error, oversight, mistakes
- 4.2. Describe the theories of accident occurrences
- 4.3. Describe the significance of body injuries and their management in the workplace
- 4.4. Describe the principles of accident prevention
- 4.5. Describe hazard identification and analysis
- 4.6. Describe human factors contributing to accidents
- 4.7. Describe theories of motivation and their application to safety
- 4.8. Describe first aid system during injuries
- 4.9. Describe material safety data sheet (MSDS)
- 4.10. Describe controlling procedures of general risks.

5. Understand the legislative measures related to health, safety and environment

- 5.1. Define: monitoring, standards, policy, audit, inspection, checklist, compliance
- 5.2. Describe the purpose of monitoring
- 5.3. Describe monitoring techniques
- 5.4. Describe identification of gaps and close the gaps
- 5.5. Describe the purpose of policy
- 5.6. Describe the elements of policy
- 5.7. Describe safety protocol
- 5.8. Describe health and hygiene system that has been mention in Bangladesh Labor Law
- 5.9. Describe safety system that has been mention in Bangladesh Labor Law
- 5.10. Describe special provisions relating to health, hygiene and safety that has been mention in Bangladesh Labor Law

PRACTICAL

1. Make a checklist of risks and its reduction/prevention methods
2. Make list of safety signs and their usage
3. Make a list of slips, trips and falls with their injuries and reduction/prevention method
4. Determine the appropriate measures to ensure safe access and egress and when working at height and below ground level.
5. Determine the main hazards associated with machinery, equipment and measures to control hazards.
6. Identify the correct procedure for lifting and carrying.
7. Determine the action to be taken in the event of someone receiving an electric shock.
8. Make a list of different types of personal protective equipment and the hazards against which they provide protection.
9. Exercise the fire fighting equipments and extinguishers to control/reduce fire accidents.
10. Make a list of symbol, abbreviations and description of physiochemical and environmental hazards
11. Make a list of safety signs
12. Make a list of bad practices and good practices.
13. Make a list of causes and remedies of accidents and injuries in RMG Factory.
14. Make a list of personal protection measures to reduce injuries.

REFERENCE BOOKS

1. R.K. Jain and Sunil S. Rao, Industrial Safety, Health and Environment Management Systems, Khanna Publishers, New Delhi, 2006.
2. Slote. L., Handbook of Occupational Safety and Health, John Wiley and Sons, New York.
3. Jensen. Roger C., Risk Reduction Methods for Occupational Safety and Health.

9053

ENVIRONMENTAL MICROBIOLOGY

T	P	C
2	3	3

AIMS

To be able to develop knowledge, skill and attitude in the field of Environmental Microbiology with special emphasis on the following:

- ✚ To be acquaint with environmental microbes and their microbial contamination.
- ✚ To be able to detecting, isolation, preservation and processing of microbial action.
- ✚ To be enable to laboratory test (Examination) of microbes their microbial action.
- ✚ To find out the role of microorganisms in industry.

SHORT DESCRIPTION

Basic concept of environmental microbiology; Classification of environmental microbes; population interaction; environmental microbes; Abiotic factors an microorganism; Microbiology of food; Microbiology of domestic water and waste water; Pathogen indicator and bacterial analysis; Industrial microbiology.

DETAIL DESCRIPTION

Introduction

1. Understand the Basic Concept of Environmental Microbiology.

- 1.1 Define Environmental Microbiology.
- 1.2 Mention the scope of Environmental Microbiology.
- 1.3 Describe the environmental microbes.
- 1.4 Mention two examples of environmental microbes.
- 1.5 Outline the economic importance of environmental microbes.

Classification of Environmental Microbiology

2. Understand the classification of Environmental Microbes.

- 2.1 Mention the objectives of classification of environmental microbes.
- 2.2 State the classification of environmental microbes.
- 2.3 Describe five major characteristics of environmental microbes.
- 2.4 Mention the units of (categories) of classification of environmental microbes.
- 2.5 Describe the nomenclature of environmental microbes.

3. Understand the population Interaction.

- 3.1 Define neutralism, commensalisms, synergism, mutualism, competition, amensalism, parasitism and predation.
- 3.2 Mention the neutralism microorganisms in the environment.
- 3.3 Describe the commensalisms of environmental microbes with example.
- 3.4 Describe the mutualism of environmental microbes with example.
- 3.5 Mention two examples of parasitism environmental microbes.
- 3.6 Describe the Rhizosphere of environmental microbes.

- 3.7 Describe the microbial plant, animal and human diseases with reference to sanitation.

Environment and Microbes

4. Understand the Environmental Microbes.

- 4.1 Mention the distribution pattern of environmental microbes.
- 4.2 Types of environmental microbes.
- 4.3 Describe the composition of microbial population in air, water and soil.
- 4.4 Describe the succession of microbial population in air, water and soil.
- 4.5 Describe the productivity of microbial population in air, water and soil.

5. Understand the Abiotic factors of an Microorganisms.

- 5.1 List the abiotic factors of microorganisms.
- 5.2 Explain the temperature resistance of microorganisms.
- 5.3 Explain the radiation sensitivity of microorganisms.
- 5.4 Explain the salinity sensitivity of microorganisms.
- 5.5 Describe the pH of microorganisms.
- 5.6 Describe the biogeochemical transformation of nitrogen, carbon, sulphur and other nutrients.
- 5.7 Describe the biodegradation of pollutants.

6. Understand the Microbiology of food.

- 6.1 Outline the microbial flora of fresh food.
- 6.2 Mention the microorganisms in food spoilage with examples.
- 6.3 Describe the microbial examination of food.
- 6.4 Describe the control method of food spoilage microbes.
- 6.5 Describe the fermented foods.
- 6.6 Explain the microorganisms as a food- single cell protein.

7. Understand the Microbiology of Domestic water and Waste water.

- 7.1 Define pathogen, parasite, host, bacteria, viruses, protozoa, algae and helminthes.
- 7.2 List the bacteria present in natural water.
- 7.3 Describe potable, non-potable and contaminated water.
- 7.4 Explain four water born bacterial diseases of human.
- 7.5 Describe water purification of individual water supplies and municipal water supplies.
- 7.6 Describe the sanitary quality of Domestic water.
- 7.7 Explain microbial characteristic of waste water.
- 7.8 Describe the microorganism in waste water treatment procedures.
- 7.9 Describe the efficiency of wastewater treatment procedures.

8. Understand the Pathogen Indicators and bacterial analysis.

- 8.1 Define indicator organisms, coliform, faecal coliform and total coliform.
- 8.2 Mention five precautionary measures for the collection of water sample for bacteriological analysis.
- 8.3 Explain two standard techniques for bacteriological examination of water.
- 8.4 Mention the characteristics of coliform bacteria.
- 8.5 Explain the standard membrane filter techniques for the identification of coliform bacteria in water.
- 8.6 Describe the procedure for running total coliform analysis by the multiple tube fermentation method.

9. Understand the Industrial Microbiology.

- 9.1 List the microorganisms used in industry.
- 9.2 Mention the major classes of product and processes in industry.
- 9.3 Describe the industrial uses of bacteria.
- 9.4 Describe the industrial uses of yeasts.

- 9.5 Describe the industrial uses of molds.
- 9.6 Describe the biologics for immunization.
- 9.7 Describe the petroleum microbiology.
- 9.8 Describe the deterioration of materials.

Practical:

1. Study the working of a compound microscope.
2. Perform a simple staining procedure.
3. Perform an experimental procedure in the measurement of microorganisms.
4. Acquainted with mold cultivation on glass slides.
5. Compare the effectiveness of disinfectants.
6. Determine the total number of microorganisms present in food products.
7. Determine the quantity of alcohol by fermentative activities of yeast cells.
8. Determine the microbiological production of sugarkraut.
9. Determine the presence of coliform bacteria in a water sample.
10. Determine the enzymatic conversion of ammonia to nitrate by soil microorganisms.
11. Determine the quality of water samples using the membrane filter method.

REFERENCE BOOKS

1. Mitchell R, (1997) Environmental Microbiology, McGraw Hill Book Company, New York.
2. Pelczar Jr MJ (2006) Microbiology, Tata McGraw Hill Publishing Company, New Delhi, p543-643.
3. ড. এস. এ. খালেক; মাইক্রোবায়োলজি
4. Cappuccino, J. G. and Sherman, N. (2009) Microbiology, a laboratory manual, Pearson education, inc 7th edition. ISSN: 978-81-317-1437-9.

6433 STRUCTURAL MECHANICS

T P C
3 3 4

AIMS

- To enable to apply the knowledge of scientific principles to problems of a mechanical nature.
- To develop an understanding of mechanical properties of materials.
- To assist in applying mathematical and geometrical calculations to the analysis of statically determinate beams.

SHORT DESCRIPTION

Mechanical properties of materials; Work, power and energy; Laws of forces; Moment; Friction; Center of gravity; Moment of inertia; Torsion on circular shaft; Shear force and Bending moment.

DETAIL DESCRIPTION

Theory:

1. MECHANICAL PROPERTIES OF MATERIALS

1.0 Understand the important aspects of mechanical properties of materials.

- 1.1 Explain the necessity to know about the mechanical properties of materials.
- 1.2 Define the following terms:
 - a. Stress, tensile stress, compressive stress, shear stress.
 - b. Strain, tensile strain, compressive strain, shear strain,
 - c. Hooke's law, modulus of elasticity and modulus of rigidity.
- 1.3 Explain stress-strain diagram of mild steel and concrete.
- 1.4 State the meaning of the followings:
 - a. Elasticity, proportional limit, yield point, ultimate stress, breaking stress, proof stress, working stress and factor of safety.
 - b. Strength, stiffness, toughness, ductility, malleability, brittleness, creep, fatigue failure, resilience, modulus of resilience, thermal stress in simple bar and Poisson's ratio.
- 1.5 Compute stress, strain, modulus of elasticity and modulus of rigidity.
- 1.6 Solve problems involving resilience, thermal stress and Poisson's ratio.
- 1.7 Compute stress developed in composite bar under tension and compression.

2. WORK, POWER AND ENERGY

2.0 Understand about the aspects of work, power and energy.

- 2.1 Define the following terms:
 - a. work
 - b. power
 - c. energy
- 2.2 Specify the units of the followings:
 - a. work
 - b. power
 - c. energy
- 2.3 Describe work done in rotation and represent by area.
- 2.4 Mention the different kinds of energy.
- 2.5 Explain the relations of potential energy and kinetic energy.
- 2.6 Solve problems involving work, power and energy.

3. LAWS OF FORCES

3.0 Understand the concept of laws of forces.

- 3.1 Explain the laws of forces.
- 3.2 Define the following terms:
 - a. force; b. coplanar force; c. non-coplanar force; d. concurrent force; e. resultant force.
- 3.3 Mention the parallelogram laws of forces.
- 3.4 State the meaning of composition and resolution of forces.
- 3.5 Compute the resultant force of -
 - a. Triangle of forces
 - b. Polygon of forces
 - c. Converse law of triangle and polygon laws of forces graphically.
- 3.6 Explain Lami's theorem.
- 3.7 Solve problems on Lami's theorem.

4. MOMENT

4.0 Understand the aspects of moment of forces.

- 4.1 Define the term moment (analytically and graphically).
- 4.2 Differentiate moment with force.
- 4.3 Explain Varignon's principle of moment.
- 4.4 Distinguish like and unlike parallel forces.
- 4.5 State the meaning of couple.
- 4.6 Mention the properties of couple.
- 4.7 Solve problems on moment of couple.

5. FRICTION

5.0 Understand the concept of frictional forces.

- 5.1 State the meaning of friction and static & dynamic friction.
- 5.2 Mention the laws of static friction.
- 5.3 Explain angle of friction and co-efficient of friction.
- 5.4 Compute friction of a body on horizontal planes.
- 5.5 Compute friction of a body on inclined planes.
- 5.6 Compute frictional force acting on a ladder.

6. CENTER OF GRAVITY

6.0 Understand the aspects of center of gravity.

- 6.1 Explain the terms: centroid and center of gravity.
- 6.2 State the axis of symmetry.
- 6.3 Compute the center of gravity by the method of moment of the following sections:
 - a. rectangular
 - b. circular

- c. semi-circular
- d. hollow
- e. I-shaped
- f. T-shaped
- g. L-shaped.

7. MOMENT OF INERTIA

7.0 Understand the concept of moment of inertia.

- 7.1 State 1st and 2nd moment of area.
- 7.2 Explain the meaning of radius of gyration.
- 7.3 Mention the theorems of moment of inertia.
- 7.4 Compute the moment of inertia of plane area about any axis of the following sections:
 - a. rectangular
 - b. circular
 - c. semi-circular
 - d. hollow
 - e. I-shaped
 - f. T-shaped
 - g. L-shaped.

8. TORSION ON CIRCULAR SHAFT

8.0 Understand the aspects of torsion on solid and hollow circular shaft.

- 8.1 State about the laws of motions.
- 8.2 Explain the term circular motion.
- 8.3 Define the terms: torsion and torsion stress.
- 8.4 Mention the assumptions of torsion stress.
- 8.5 Find the relation between torsion stress and strain.
- 8.6 Express the derivation of the formula for finding torque.
- 8.7 Determine the relations among torsion, horse power and velocity of shaft.
- 8.8 Solve problems involving torsion.

9. SHEAR FORCE AND BENDING MOMENT

9.0 Understand about the shear force (SF) and bending moment (BM).

- 9.1 Define the term beam.
- 9.2 List different kinds of beams.
- 9.3 State the meaning of load.
- 9.4 Mention various kinds of load on beams.
- 9.5 State the meaning of shear force and bending moment.
- 9.6 Differentiate between shear force and bending moment.

- 9.7 Mention the sign conventions of shear force and bending moment.
- 9.8 List the characteristics of shear force and bending moment diagram.
- 9.9 Draw SF and BM diagram of cantilever beams with point load, distributed load and both.
- 9.10 Draw SF and BM diagram of simply supported beams with point load, distributed load and both.

Practical:

1. Determine the compressive stress of a timber specimen.
2. Draw stress-strain curve of mild steel with test results.
3. Determine the hardness of mild steel plate.
4. Determine the stiffness of mild steel plate.
5. Determine the brittleness of cast iron.
6. Show the resultant of force by using the force board.
7. Prove the Lami's theorem by using the force board.
8. Determine the co-efficient of friction of timber, concrete and mild steel.
9. Determine reactions of a beam by using spring balance.

REFERENCE BOOKS

1. Structural Mechanics -- W Morgan and D T Williams
2. Structural Mechanics -- Singer / Popov
3. Mechanics of Materials -- Philip Gustave Laurson and Williams Junkin
Cox
4. Structural Mechanics - A. K. Upadhyay Published by SK Kateria & Sons,
India.

S.K Kataria & Sons

- 5 Applied Mechanics - A. K. Upadhyay

- Introduction
- Laws of Forces
- Moment
- Friction
- Centre of Gravity
- Moment of Inertia
- Laws of Motion
- Motion of Connected Bodies
- Circular Motion
- Simple Lifting Machines

- Laboratory Experiments

6 Structural Mechanics - A. K. Upadhyay

- Properties of Materials
- Stresses and strains
- Shear Force and Bending Moment
- Centre of Gravity
- Moment of Inertia
- Bending and Shear Stresses
- Slope and Deflection
- Column and Struts
- Combined Direct and Bending Stress
- Analysis of Trusses
- Experiments

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THEORY OF STRUCTURE

T P C
3 3 4

AIMS

- To be able to consolidate and extend the fundamental understanding of the behavior of statically determinate structures i.e. beams, frames etc.
- To be able to develop awareness of structural behavior such as deflection and stability of masonry dam.
- To be able to develop understanding for selection of suitable section of beam and member of the truss.

SHORT DESCRIPTION

Shear force and bending moment of beams; Stresses in beams; Deflection of beams; Joints and connections; Forces in frames; Masonry dam; Column; Moving loads; Thin Cylindrical shells.

DETAIL DESCRIPTION

Theory:

1 Understand shear force and bending moment of beams.

- 1.1 State different type of loads on beam.
- 1.2 Mention different types of support condition.
- 1.3 Define point of contraflexure or inflection point.
- 1.4 Define dangerous section
- 1.5 Explain the relations between shear force and bending moment.
- 1.6 Characteristics of SF and BM diagrams.
- 1.7 Solve problems on SF and BM of cantilever beam with concentrated load, distributed load, inclined load, couples, pure moment and combined loads.
- 1.8 Solve problems on SF and BM of simply supported beam with concentrated load, distributed load, inclined load, couples, pure moment and combined loads.
- 1.9 Solve problems on SF and BM of overhanging beam with concentrated load, distributed load, inclined load, couples, pure moment and combined loads.
- 1.10 Solve problems on SF and BM diagram to loading diagram of cantilever, simply supported and overhanging beams.

2 Understand the bending (flexural) stresses in beams.

- 2.1 State the meaning of bending stresses in beam.
- 2.2 List the assumptions of bending stresses in beam.
- 2.3 Differentiate between bending moment and bending stress.
- 2.4 Express and derivation of the formula for bending stress.
- 2.5 State the meaning of elastic section modulus.
- 2.6 Solve problems on bending stresses of circular, rectangular, I, T, L and hollow sections of beams.
- 2.7 Solve problems on section modulus of circular, rectangular, I, T, L and hollow sections of beams.

3 Understand the shearing stresses in beams.

- 3.1 State the meaning of shearing stresses in beam
- 3.2 Differentiate between maximum and average shear stress.
- 3.3 Relate maximum shear stress and average shear stress for rectangular, circular and triangular section.
- 3.4 Express the derivation of the formula for shearing stress.
- 3.5 Solve problems on shearing stresses of circular, rectangular, I , T, L and hollow sections of beams.
- 3.6 Determine the section of homogeneous beam with respect to shearing stress and bending stress.

4 Understand the deflection of beams.

- 4.1 Define the meaning of deflection of beam and elastic curve.
- 4.2 List the assumptions of deflection of beam.
- 4.3 State the maximum allowable deflection for beam, RCC slab and steel trusses.
- 4.4 Express the derivation of equation for elastic curve
- 4.5 State the 1st and 2nd area moment proposition.
- 4.6 Compute the slope of elastic curve for cantilever beam with concentrated and distributed load.
- 4.7 Compute the maximum deflection for cantilever beam with concentrated and distributed load.
- 4.8 Compute the slope of elastic curve for simply supported beam with symmetrically concentrated and distributed load.
- 4.9 Compute the maximum deflection for simply supported beam with symmetrically concentrated and distributed load.
- 4.10 Compute the maximum deflection for simply supported beam with unsymmetrical concentrated load.

5 Understand the importance of joints.

- 5.1 Define joint, pitch, back pitch and repeating section.
- 5.2 State the necessity of joints.
- 5.3 Mention the classification of joints.
- 5.4 State the meaning of efficiency of joints.
- 5.5 Explain the modes of failure and remedial measures of riveted joints.
- 5.6 Solve problems on simple lap joint subjected to axial load only.
- 5.7 Solve problems on butt joint subjected to axial load only.

6 Understand the significance of welded connections.

- 6.1 Define terms: Leg, Throat, Fillet, Reinforcement etc.
- 6.2 State the significance of welded connections.
- 6.3 Classify different types of welded connections.
- 6.4 Mention the merits of welded connections.
- 6.5 Mention the demerits of welded connections.
- 6.6 Distinguish between joints and connections.
- 6.7 Solve problems on butt weld connection subjected to axial load only.
- 6.8 Solve problems on fillet weld connection subjected to axial load only.

7 Understand the action of forces in frames.

- 7.1 Define the terms: truss, tie, strut, perfect, imperfect, deficient, redundant, web and chord member.
- 7.2 Mention different types of roof trusses and bridge trusses.

- 7.3 State the fundamental assumptions in trusses.
- 7.4 Describe the methods of computing forces in trusses.
- 7.5 Determine the forces on frames for warren truss, cantilever, jib crane and howe truss with dead load by Analytical (joint and moment method) and Graphical method.

8 Understand the stability of masonry dam.

- 8.1 Define dam and mention the functions of a dam.
- 8.2 Mention the different types of dam.
- 8.3 Explain the stability of a masonry dam.
- 8.4 State the meaning of middle third law.
- 8.5 Express the derivation of the equation for minimum width of the base for just no tension.
- 8.6 Calculate the maximum and minimum pressure on the foundation bed for rectangular dam
- 8.7 Calculate the maximum and minimum pressure on the foundation bed for trapezoidal dam having water face vertical only.
- 8.8 Solve problems on stability and suitable section of the dam.

9 Understand the elastic buckling of columns.

- 9.1 State the meaning of short and long column.
- 9.2 Mention the type of columns on the basis of end conditions.
- 9.3 Compare the equivalent length of different columns.
- 9.4 Express the derivation of the Euler's formula for flexural buckling of a pin ended strut/column.
- 9.5 Calculate the safe load on column using Euler's formula.
- 9.6 State the Rankine-Gordon formula.
- 9.7 Calculate the safe load on column using Rankine-Gordon formula.

10 Understand the concept of moving loads.

- 10.1 State the meaning of moving load.
- 10.2 Classify different types of moving loads.
- 10.3 State the meaning of influence line.
- 10.4 Draw influence line for single concentrated load and reaction of a beam.

11. Understand the concept of Thin Cylindrical Shells.

- 11.1 Introduction.
- 11.2 Failure of a cylindrical shell due to an internal pressure.
- 11.3 Stresses in a thin cylindrical shell.
- 11.4 Circumferential stress.
- 11.5 Longitudinal stresses.
- 11.6 Design of thin cylindrical shells

Practical:

- 1 Determine shear force & bending moment at different sections of simply supported beam with different types of load and draw the diagrams.
- 2 Determine shear force & bending moment at different sections of over hanging beam with different types of load and draw the diagrams.
- 3 Determine the position of dangerous section and inflection point or point of contra flexure of over hanging beam.
- 4 Determine the bending stresses of circular, rectangular, I , T , L & hollow sections of beams and draw the diagrams.

- 5 Determine the shearing stresses of circular, rectangular, I , T , L & hollow sections of beams and draw the diagrams.
- 6 Determine the section modulus of circular, rectangular, I , T , L & hollow sections of beams and draw the diagrams.
- 7 Determine the section of homogeneous beam with respect to shearing stress and bending stress.
- 8 Determine the deflection of cantilever and simply supported homogeneous beam with respect to concentrated and distributed load.
- 9 Draw the neat sketches of different type of riveted joints and welded connections showing the mode of failures.
- 10 Determine the forces developed on the member of a truss graphically.
- 11 Prepare some models of different types of truss with suitable materials.
- 12 Determine the buckling load of both ends fixed homogeneous column.

REFERENCE BOOKS

2. Theory of simple structure
 - T C Shed and J Vawter
2. Strength of materials and structures
 - J Case and A H Chilver
3. Theory of structures
 - R S Khurmi
4. Strength of Materials
 - R S Khurmi

9054 GEOGRAPHIC INFORMATION SYSTEM (GIS) AND REMOTE SENSING

T	P	C
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AIMS

To be able to develop knowledge, skill and attitude in the field of geographic information system (GIS) and remote sensing (RS) with special emphasis on the following:

- ✚ Concept of geographic information system (GIS) and remote sensing (RS).
- ✚ Data model, data structure and geospatial data.
- ✚ Spatial database and spatial analysis.
- ✚ Sensors and microwave sensors.
- ✚ Image analysis.
- ✚ Application field of GIS & RS.

SHORT DESCRIPTION

Concept of geographic information system; Data model and structure; Input of geospatial data; Spatial database; Spatial analysis; Fundamental concept of remote sensing; Principles of remote sensing; Sensors; Microwave remote sensing; Image analysis; and Application remote sensing.

DETAIL DESCRIPTION

10. Understand the basic concept of Geographic Information System (GIS).

- 10.1 Definition of Geographic Information System (GIS)
- 10.2 Components of GIS.
- 10.3 Why is a GIS needed?
- 10.4 Required Functions for GIS.
- 10.5 Computer System for GIS.
- 10.6 GIS as a Multidisciplinary Science.
- 10.7 Areas of GIS Applications.

11. Understand the Data Model and Structure.

- 11.1 Data Model
- 11.2 Geometry and Topology of Vector Data
- 11.3 Topological Data Structure
- 11.4 Topological Relationships between Spatial Objects
- 11.5 Geometry and Topology of Raster Data
- 11.6 Topological Features of Raster Data
- 11.7 Thematic Data Modeling
- 11.8 Data Structure for Continuous Surface Model

12. Understand the Input of Geospatial Data.

- 12.1 Required Data Sources for GIS
- 12.2 Digitizers for Vector Data Input
- 12.3 Scanner for Raster Data Input.
- 12.4 Input Digital Mapping by Aerial Photogrammetry
- 12.5 Remote Sensing with Satellite Imagery
- 12.6 Rasterization
- 12.7 Vectorization
- 12.8 Advanced Technologies for Primary Data Acquisition

13. Understand the Spatial Database.

- 13.1 Define Spatial Data.
- 13.2 Concept of Spatial Database

- 13.3 Design of Spatial Database
- 13.4 Database Management System
- 13.5 Hierarchical Model
- 13.6 Relational Database
- 13.7 Object Oriented Database

14. Understand the Spatial Analysis.

- 14.1 Define spatial analysis.
- 14.2 Query
- 14.3 Reclassification
- 14.4 Coverage Rebuilding
- 14.5 Overlay of Raster Data
- 14.6 Overlay of Vector Data
- 14.7 Connectivity Analysis
- 14.8 Shape Analysis and Measurement

15. Fundamental concept of Remote Sensing.

- 15.1 Define Remote Sensing.
- 15.2 Mention the remote sensing platforms.
- 15.3 Describe electromagnetic radiations.
- 15.4 Classification of electromagnetic radiations.
- 15.5 Describe the electromagnetic spectrum.
- 15.6 Interactions with the atmosphere.
- 15.7 Describe the radiation target interactions.

16. Principles of Remote Sensing.

- 16.1 Passive and Active Remote Sensing system.
- 16.2 List the types of Remote Sensing with respect to wavelength regions.
- 16.3 Define Radiometry.
- 16.4 Describe the Reflectance.
- 16.5 Describe the Spectral Reflectance of Land covers.
- 16.6 Describe the Spectral characteristics of solar radiation.

- 16.7 Explain Transmittance of the atmosphere.
- 16.8 Problem solved of electromagnetic radiation, absorption, scattering and transmittance on the atmosphere.
- 16.9 Types of Remote Sensing Image.

17. Understand the Sensors.

- 17.1 List the types of Sensor.
- 17.2 Mention the Satellite Characteristics: orbits and swaths.
- 17.3 Mention the spatial resolution, pixel size and scale.
- 17.4 Describe the spectral resolution.
- 17.5 Describe the radiometric resolution.
- 17.6 Describe the temporal resolution.
- 17.7 Explain Cameras and Aerial Photography.
- 17.8 Explain Multispectral scanning.
- 17.9 Describe the Thermal Imaging.
- 17.10 Describe the Geometric Distortion.
- 17.11 Mention the Weather Satellites.
- 17.12 Describe the Land observation satellite.
- 17.13 Describe the Marine observation satellite.
- 17.14 Describe the Data reception, transmission and processing.

18. Understand the Microwave Remote Sensing.

- 18.1 Principles of microwave remote sensing.
- 18.2 Types of microwave sensor.
- 18.3 Mention the basic concept of Radar.
- 18.4 Describe the Real Aperture Radar (RAR).
- 18.5 Describe the Synthetic Aperture Radar (SAR).
- 18.6 Explain the geometry of Radar imagery
- 18.7 Describe the Radar images on Terrains.
- 18.8 Describe the microwave Altimeter.
- 18.9 Mention the wave measurement by Radar.
- 18.10 Problem solved on Radar imagery.

19. Understand the Image Analysis.

- 19.1 Define Image Analysis.
- 19.2 Mention the elements of visual Interpretation.
- 19.3 Describe Digital Image Processing.
- 19.4 Describe the Pre-processing.
- 19.5 Describe the Image Enhancement.
- 19.6 Describe the Image Transformations.
- 19.7 Explain the Image classification and Analysis.
- 19.8 Describe the Data Integration and Analysis.

20. Understand the Applications of Remote Sensing.

- 20.1 Mention the applicable field of remote sensing.
- 20.2 Application on agriculture: crop type , mapping & crop monitoring.
- 20.3 Application on forestry:
- 20.4 Application on geology
- 20.5 Application on hydrology: flood delineating & mapping, soil moisture.
- 20.6 Application on sea ice type, concentration & its motion.
- 20.7 Application on land cover-land use change (Rural/Urban).
- 20.8 Application on mapping: Planimetry, DEM's & topographic mapping.
- 20.9 Application on ocean & coastal monitoring.

Practical:

- 1. Perform-
 - a) Import of digital data in Arcview GIS analyzer.
 - b) Save the digital data
 - c) Add external data
- 2. Make spatial data usable for:
 - a) Flow chart
 - b) Construction topology
 - c) Steps using for arc edit
 - d) Checking error

- e) Editing error
- f) Reconstruction topology
- 3. manage database by-
 - a) creating tic coverage containing real world coordinate.
 - b) Projecting coordinate
 - c) Transforming coverage to real world coordinate
- 4. perform-
 - a) Data conversion from Vector to Raster.
 - b) Data conversion from Raster to Vector.
- 5. Perform the reclassification of thematic data to spatial data.
- 6. perform the –
 - a) import the remote sensing images
 - b) represent the images with true color
 - c) represent the images with false color
- 7. perform the –
 - a) classified the raw image
 - b) resampling the classified image
 - c) projection image with real world coordinate
 - d) explore the analyzed image
- 8. perform the –
 - a) image classification
 - b) image analysis
- 9. Perform the density slicing of image.
- 10. Perform the delineation of vegetation health status.

REFERENCE BOOKS

- 5. Murai, S. (1999) GIS work book (Fundamental theoretical course) Japan Association of Surveyors (JAS), 1-3-4 Koishigawa, Bunkyo-ku, Tokyo 112, Japan.

6. Murai, S. (1999) GIS work book (Fundamental technical course) Japan Association of Surveyors (JAS), 1-3-4 Koishigawa, Bunkyo-ku, Tokyo 112, Japan.
7. CCRS/CCT (A Canada Center for Remote Sensing) () Fundamental of Remote Sensing, Remote Sensing Tutorial,
8. Murai, S. (1999) Remote Sensing Note, Japan Association of Remote Sensing (JARS)
9. Gibson, P. J. (2000) Introductory Remote Sensing: Principles and Concept., Routledge, London, UK.
10. ILWIS 3.0 Academic (2001): Integrated Land and Water Information System, Unit Geo Software Development, IT Department, International Institute for Aerospace Survey and Earth Sciences, Enschede, The Netherlands.
11. Software: Arcveiw 3.3 for GIS and ILWIS 3.6 version free downloadable from site: http://www.itc.nl/ilwis/software/version_6.asp

4-YEAR DIPLOMA-IN-ENGINEERING PROGRAM

Environmental Technology (90)

SYLLABUS
(COURSE STRUCTURE-2010)

SIXTH SEMESTER

T P C

3 3 4

Water Supply & Sanitation Engineering

AIMS

To be able to develop knowledge, skill and attitude in the area of water collection and transmission and water distribution with special emphasis on:

- Source of municipal water.
- Collection and transmission system of water.
- Different types of pumps used in water supply.
- Pumping net works and service connection in water pump.
- Different types of valves used in water supply.
- Design layout of distribution system.
- Different types of reservoirs.
- Construction and maintenance of distribution system.
- Methods of distribution of water.
- Alternatively water supply technology for small community
- Environmental sanitation
- General consideration of sewerage supply.
- Septic tanks
- Sewer pipes and joints
- Appurtenances and their purposes.
- Siphons and sewer pumps
- Designing of sewers
- Principle of construction of sewers
- Maintenance of sewer
- Characteristic of sewage

SHORT DESCRIPTION

Sources of water supply Collection and transmission system of water; Different types of pumps used in water supply; Piping networks and service connections in water pump; Different types of valves used in water supply; Design layout of distribution system; Different types of reservoirs; Constructions and maintenance of distribution system; Methods of distribution of water; Waste water collection; Pumps used in water and waster water pumping; Environmental sanitation; General consideration of sewage systems; Septic tanks; Sewer pipes and joints; Appurtenances and their purposes; Siphons and sewage pumps; of construction of sewers; Maintenance of sewer.

DETAIL DESCRIPTION

1. Understand the introduction to water supply

- 1.1 Describe the importance of water supply
- 1.2 Describe the history and development of water supply
- 1.3 Describe the objectives of water supply
- 1.4 Mention the elements of water supply
- 1.5 Describe the planning and design considerations
- 1.6 Describe outline of report for water supply scheme

2 Understand the quality of water

- 2.1 Mention the factors of estimating the quantity of water
- 2.2 Describe the rate of demand
- 2.3 Describe the factors affecting rate of demand
- 2.4 Describe the Variations in rate of demand

3 Understand the sources of water supply

- 3.1 Mention the sources of water
- 3.2 Describe surface runoff
- 3.3 Describe precipitation
- 3.4 Mention the types of sources
- 3.5 Describe surface sources
- 3.6 Describe underground sources
- 3.7 Describe groundwater aquifer

3.8 Describe ground water in Bangladesh

3.9 Describe rain water sources

3.10 Describe comparison of surface and underground sources of water

4 Understand the concept of pumps

4.1 Describe necessity of pumps

4.2 Mention the choice of type of pumps

4.3 Mention the types of pumps

4.4 Describe air lift pumps

4.5 Describe centrifugal pumps

4.6 Mention the displacement pumps

4.7 Describe reciprocating pumps

4.8 Describe rotary pumps

4.9 Describe hydraulic pumps

4.10 Describe jet pump

4.11 Describe power for pumps

4.12 Describe horse-power of pumps

4.13 Exercise some problem relating to pumps

5 Understand the conveyance of water

5.1 Define conveyance of water

5.2 Define intakes

5.3 Describe factors of selection of site of an intake

5.4 Describe design of intakes

5.5 Mention the types of intakes

5.6 Describe canal intake

5.7 Describe reservoir or lake intake

5.8 Describe river intake

5.9 Describe portable intake

5.10 Describe intake towers

5.11 Describe uses of pipes as conduit

5.12 Measure the water flow through a pipe

5.13 Mention the materials which are used for pipes

- 5.14 Describe asbestos cement pipes, cast iron pipes, cement concrete pipes, copper pipes, galvanized iron pipes, lead pipes, plastic pipes, steel pipes, wood pipes and wrought iron pipes.
- 5.15 Define pipe corrosion
- 5.16 Describe the factors contributing pipe corrosion
- 5.17 Mention the effects of pipe corrosion
- 5.18 Explain the theories of pipe corrosion
- 5.19 Describe the prevention of pipe corrosion

6 Understand the transmission of distribution system of water

- 6.1 Define water transmission and water distribution
- 6.2 Mention the purpose of water transmission and water distribution pipe line
- 6.3 Classify of transmission and distribution system
- 6.4 Describe gravity- flow system
- 6.5 Describe the system direct pumping
- 6.6 Describe the system with pumping and storage
- 6.7 Describe different types of distribution networks
- 6.8 Describe alternative water supply technologies

7 Understand the pipe appurtenances

- 7.1 List some pipe appurtenances
- 7.2 Describe air valves
- 7.3 Describe bib cocks
- 7.4 Describe fire hydrant
- 7.5 Describe reflux valves
- 7.6 Describe relief valves
- 7.7 Describe scour valves
- 7.8 Describe sluice valves
- 7.9 Describe stop cocks
- 7.10 Describe water meters

8 Understand the basic concept of sanitary engineering

- 8.1 Define sanitation, municipal sewage, domestic sewage, sewer, refuse, sewerage, invert, human waste, industrial waste.

- 8.2 Mention the purposes of sanitation
- 8.3 Describe the principles of sanitation
- 8.4 Describe the factors of sanitary projects
- 8.5 Describe the outline of report for sanitary project

9 Understand the collection and conveyance of refuse

- 9.1 List the methods of carrying refuse
- 9.2 Describe conservancy system
- 9.3 Describe water carriage system
- 9.4 Compare between conservancy and water carriage systems
- 9.5 List the systems of sewerage
- 9.6 Describe separate systems
- 9.7 Describe combined systems
- 9.8 Describe partially separate system
- 9.9 Describe the conditions favourable for separate system
- 9.10 Describe the conditions favourable for combined system
- 9.11 Describe the right choice of the system
- 9.12 Describe the patterns of refuse collection
- 9.13 Describe sanitation practice in Bangladesh
- 9.14 Mention the factors for sanitation in Bangladesh.

10 Understand the quantity of sewage

- 10.1 List the categories of sewage
- 10.2 Describe dry weather flow
- 10.3 Describe storm water
- 10.4 List the methods for calculating the quantity of storm water for the purpose of designing sewers
- 10.5 Describe rational method
- 10.6 Describe empirical formulas which are used for determining the quantity of storm water

11 Understand the construction of sewers

- 11.1 Describe the materials for sewers

- 11.2 Describe asbestos cement sewers, brick sewers, cast-iron sewers, cement concrete sewers, corrugated iron sewers, plastic sewers, steel sewers, stoneware sewers and wood sewers
- 11.3 Describe the shapes of sewers
- 11.4 List the types of joints in sewers
- 11.5 Describe cement mortar joints, collar joints, flexible or bituminous joints, mechanical joints and open joints
- 11.6 Describe laying and testing of sewers
- 11.7 Describe reasons of ventilation of sewers
- 11.8 Describe methods of ventilation
- 11.9 Describe cleaning and maintenance of sewers
- 11.10 Describe the uses of surface drains
- 11.11 Describe the shapes of surface drains

12 Understand the design of sewers

- 12.1 Describe the principles of design of sewers
- 12.2 Describe minimum and maximum velocities of sewers
- 12.3 Describe the factors influence the flow of sewage in sewers
- 12.4 List the empirical formulas for design of sewers
- 12.5 Describe Chezy's formula, Bazin's formula, Manning's formula, Crimp and Bruges' formula and Hazen and Williams' formula
- 12.6 Describe sizes of sewers
- 12.7 Describe design procedure
- 12.8 Exercise some problem relating to design of sewers

13 Understand the sewer appurtenances

- 13.1 Define sewer appurtenances
- 13.2 List the important sewer appurtenances
- 13.3 Describe catch basins or catch pits
- 13.4 Describe clean outs
- 13.5 Describe drop manholes
- 13.6 Describe flushing tanks
- 13.7 Describe grease and oil traps

- 13.8 Describe inlets
- 13.9 Describe inverted siphons
- 13.10 Describe lampholes
- 13.11 Define manholes
- 13.12 Describe objects of manholes
- 13.13 Describe principles of design of a manhole
- 13.14 Describe classification of manholes
- 13.15 Describe component parts
- 13.16 Describe storm water regulators

14 On-site human waste management technological options

- 14.1 Define Human waste management
- 14.2 Describe simple pit latrine
- 14.3 Describe ventilated improved pit (VIP) latrine
- 14.4 Describe reed odorless earth closet (ROEC)
- 14.5 Describe compost latrines.
- 14.6 Describe pour flush sanitation technologies.
- 14.7 Describe Aqua –privies
- 14.8 Describe septic Tank system .
- 14.9 Describe communal sanitation system.
- 14.10 Problem solved of various worked example.

15 Understand the concept of house drainage

- 15.1 Define house drainage
- 15.2 Describe the principles of house drainage
- 15.3 Define traps
- 15.4 Describe function of traps
- 15.5 Describe the requirements of a good trap
- 15.6 Describe various of traps

- 15.7 Define siphonage, anti-siphonage pipe, cowl, fresh air inlet, soil pipe, vent pipe, waste pipe
- 15.8 List the common sanitary fittings
- 15.9 Describe systems of plumbing
- 15.10 Describe drainage plans of buildings
- 15.11 Describe testing of drains and pipes

16. Understand the treatment of Human waste and waste water

- 16.1 Mention the composition of human wastes
- 16.2 Objectives of human waste treatment
- 16.3 Mention the principles of waste treatment
- 16.4 Describe on-site waste treatment
- 16.5 Describe Brogan reverie from waste treatment
- 16.6 Describe conventional waste water treatment.
- 16.7 Describe waste stabilization ponds
- 16.8 Describe Duckweed based waste water treatment.
- 16.9 Problem solved of examples.

PRACTICAL

1. Prepare a model of septic tank
2. Prepare a model of soak pit
3. Design reservoir for rain water harvesting
4. Sketch the pipeline network for rural water supply
5. Disassemble a reciprocating pump, clean all parts and then reassemble it
6. Disassemble a centrifugal pump, clean all parts and then reassemble it
7. Find out the flow rate of water supply
8. Draw a neat sketch of a under ground water reservoir
9. Sketch different types of plumbing fixtures
10. Sketch layout plan of pipe lines for latrine
11. Draw a neat sketch of different components of small bone sewer system
12. Prepare a model of ventilated improved pit (VIP) latrine.
13. Prepare a model Double vault compost latrine.
14. Sketch of different types of sewers.

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1. Water Supply and Sanitary Engineering [Environmental Engineering] by S. C. Rangwala. Charotar Publishing House, India (2006).
2. Water Supply & Sanitation- Rural and Low Income Urban Communities by M. Feroze Ahmed and Md. Mujibur Rahman. ITN-Bangladesh, BUET, Dhaka, Bangladesh (2000).

9062 INSTRUMENTAL TECHNIQUES IN ENVIRONMENTAL ANALYSIS

T P C
1 3 2

AIMS

To be able to develop knowledge, skill and attitude in the field of instrumental techniques in environmental analysis with special emphasis on:

- Basic instrument in Environmental analysis
- pH meter
- Conductrometry
- chromatography
- gas analyser
- Colorimetry
- X-ray fluorescence and Infra red spectroscopy
- Emission spectroscopy and flame photometry
- Atomic absorption spectroscopy
- Nephelometry and Turbidometry

SHORT DESCRIPTION

Instrumental techniques in environmental analysis; pH meters; conductance;; chromatograph; industrial gas analyzers; X-ray fluorescence; Emission spectroscopy;; Nephelometry and Turbidometry;

DETAIL DESCRIPTION

Theory:

1 Understand the basic concepts of instrumental techniques in environmental analysis.

- 1.1 Define instrumental techniques.
- 1.2 Mention the elements of an analytical instrument.
- 1.3 Describe the basic concepts of environmental pollution.
- 1.4 Describe different types of gas pollutants.
- 1.5 Describe the concentration of various gas pollutants.
- 1.6 Describe air pollution monitoring instruments.
- 1.7 Explain automated wet-chemical air analyser.
- 1.8 Define electronic and digital instrumentation system.

2 Understand the features of pH meters.

- 2.1 Define pH Value.
- 2.2 Explain the principle of pH measurement.
- 2.3 Describe the pH scale and buffer solution.
- 2.4 Describe different types of electrodes for pH measurement.
- 2.5 Describe the care of glass electrodes.
- 2.6 Discuss the considerations governing the design of pH meter.
- 2.7 Explain the construction and principle of operation of null-detector type pH meter.
- 2.8 Describe the construction and operation of digital pH meter.
- 2.9 Describe industrial pH meter.

3 Understand the features of conductivity meter.

- 3.1 Define conductance.
- 3.2 Discuss the method of measurement of conductance.
- 3.3 Describe conductivity cell.
- 3.4 Describe conductivity measurement using high frequency method.
- 3.5 Describe the construction and operation of conductivity meter.

4 Understand the concepts of chromatographic instruments.

- 4.1 Define chromatograph.
- 4.2 Describe the basic parts of a gas chromatograph.
- 4.3 Explain the operation of gas chromatograph.
- 4.4 Describe chromatographic column.

5 Understand the features of industrial gas analyzers.

- 5.1 Define gas analyzer.
- 5.2 Describe different types of gas analyzers.
- 5.3 Describe paramagnetic oxygen analyzer.
- 5.4 Explain the principle of Hertman and Braun oxygen analyzer.
- 5.5 Describe infrared gas analyser.

6 Understand the X-ray fluorescence.

- 6.1 Define fluorescence.
- 6.2 Mention the principle of X-ray fluorescence technique in instrumental analysis.
- 6.3 Draw a schematic diagram of a X-ray fluorescence apparatus.
- 6.4 Describe the working of a X-ray fluorescence apparatus.
- 6.5 Mention the application of X-ray fluorescence in qualitative and quantitative analysis.

7 Understand the emission spectroscopy.

- 7.1 Define emission spectroscopy.
- 7.2 Describe emission spectroscopy.
- 7.3 Explain the principles of emission spectroscopy.
- 7.4 Describe different types of emission spectra.
- 7.5 Describe the elements of equipment for emission spectroscopy.
- 7.6 Describe the spectral instrument used in emission spectroscopy.
- 7.7 Draw a schematic diagram of a prim type spectral instrument and describe its workings.
- 7.8 Mention the application of emission spectroscopy.

8 Understand the nephelometry and turbidimetry.

- 8.1 Define nephelometry and turbidimetry.
- 8.2 Describe nephelometri analysis and turbidimetry analysis.
- 8.3 Explain the principles of nephelometry and turbidimetry analysis.
- 8.4 Explain Bonger lambert Beer equation.
- 8.5 Describe the operating condition of nephelometry and turbidimetry analysis.
- 8.6 Describe the sources of monochromatic radiation used in nephelometry and turbidimetry analysis with spectrophotometer.

- 8.7 Describe the cells and detectoy used in nephelometric and turbidimetric analysis with spectrophotometer.
- 8.8 Describe experimental technique and calculation in sephelometric and turbidimateric analysis.
- 8.9 Mention the appplication nephelometry and turbidimetry in experimental pollution analysis.

Practical:

1. Draw the operation of colorimeter.
2. Draw the operation of spectrophotometer.
3. Draw the operation of atomic absorption spectrophotometer.
4. Draw the schematic representation of a pH meter operation.
5. Identify different parts of gas chromatograph.
6. Draw the schematic representation of gas chromatograph operation.
7. Draw the operation of oxygen analyzer.
8. Draw the operation of conductivity meter.
9. Draw the operation of air pollution monitoring instrument.
10. Draw a schematic representative of a flame spectrophotometer.
11. Draw a block diagram of a NMR spectrometer.
12. Draw the schematic representation of a X-Ray florescence apparatus.
13. Draw the schematic representation of a hollow cathode lamp.
14. Draw the schematic representation of a single beam absorption instrument.
15. Draw the schematic representation of a double beam absorption instrument.

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AIMS

- To be able to understand the properties of reinforced cement concrete (RCC).
- To be able to select the suitable size of reinforced concrete beams & lintels with reinforcement.
- To be able to supervise the placing of reinforcement for beams & lintel.

SHORT DESCRIPTION

Reinforced cement concrete; Theory of bending; Investigation of beam; Shear stress and bond stress; Design of reinforced cement concrete rectangular beam, T-beam, double reinforced beam and lintel.

DETAIL DESCRIPTION**Theory:**

- 1 Understand the different type of cement concrete works.**
 - 1.1 Describe the plain concrete, reinforced concrete and prestressed concrete.
 - 1.2 Describe the different uses of the plain concrete, reinforced concrete and prestressed concrete.
 - 1.3 Mention the advantages, disadvantages & limitations of the plain concrete.
 - 1.4 Mention the advantages, disadvantages & limitations of the reinforced concrete.
 - 1.5 Mention the advantages, disadvantages & limitations of the prestressed concrete.
- 2 Understand the structural safety, design code and safety provision.**
 - 2.1 Explain the need for structural safety.
 - 2.2 Solve simple problems using the design codes.
 - 2.3 Explain the necessity for safety provision.
- 3 Understand about the loads in designing reinforced concrete works.**
 - 3.1 Define the meaning of load.
 - 3.2 Classify different kinds of loads.
 - 3.3 Define Richter scale, tectonic plate and epicenter.
 - 3.4 Explain the necessity of considering the seismic load and wind load in designing reinforced concrete works.
 - 3.5 Mention the significant of the thrust (like tidal, cyclones etc.) to be consider in designing reinforced concrete structure in coastal zone.
- 4 Understand stress, strain and elasticity of concrete.**
 - 4.1 State the meaning of stress, strain, ultimate stress and allowable stress of concrete.
 - 4.2 Define young modulus of elasticity of concrete.
 - 4.3 Calculate young modulus of elasticity of concrete.

- 4.4 Interpret stress-strain curve of steel and concrete.
- 4.5 Mention the purpose of compression test of concrete.
- 4.6 State the different size & shape of moulds for compression test.
- 4.7 Describe test procedure of crushing cubes and cylinders for compression test.
- 4.8 Determine ultimate stress of concrete (f'_c) and allowable stress of concrete (f_c).
- 4.9 Determine the allowable shear stress of concrete using ultimate stress of concrete.
- 5 Understand the properties & behavior of reinforcing steel used in RCC.**
 - 5.1 List the different types & grades of steel used in RCC and prestressed concrete.
 - 5.2 Mention the advantages of uses of mild steel in RCC.
 - 5.3 Describe the scope of using welded wire fabric in RCC.
 - 5.4 Mention the characteristics of plain bar, deformed bar and twisted bar and tendon.
 - 5.5 Mention the advantages of uses of deformed and twisted bar in RCC.
 - 5.6 State the minimum reinforcement used in RCC beam and slab.
- 6 Understand the flexure formula of homogeneous beam.**
 - 6.1 Define resisting moment.
 - 6.2 Explain the stress diagram of a loaded beam.
 - 6.3 Identify compression and tension zones of a homogenous beam.
 - 6.4 Express the derivation of the flexure formula for homogeneous beam.
 - 6.5 Solve the problems on homogeneous rectangular beam.
- 7 Understand the concept of transformed section of beam.**
 - 7.1 Define transformed section.
 - 7.2 Explain the theory of transformed section with sketches.
 - 7.3 Express the derivation of the equation for investigating the stresses developed in concrete and steel by transformed section method.
 - 7.4 Calculate the stresses developed in rectangular beam and T-beam in WSD method.
 - 7.5 Explain balanced reinforced beam, under reinforced beam and over reinforced beam.
 - 7.6 Mention the effect of under reinforcement and over reinforcement in RCC beams.
- 8 Understand the flexure formula for RCC beam in working stress design (WSD) method.**
 - 8.1 State the assumptions used in developing the flexure formula.
 - 8.2 Explain the stress diagram of a loaded RCC beam.
 - 8.3 Mention the notations used in flexure formula in WSD method.
 - 8.4 Express the derivation of the flexure formula for RCC beam in WSD method.
 - 8.5 Solve problems of flexure formula based on WSD method.
- 9 Understand the shear stress developed in RCC beams.**
 - 9.1 Explain the effects of shear force and stress in RCC beams.
 - 9.2 State the meaning of diagonal tension.
 - 9.3 Explain the causes of creating diagonal tension in RCC beams.
 - 9.4 Express the derivation of the formula to determine shear stress developed in RCC beams.
 - 9.5 Solve the problems on shear stress developed in WSD method.
 - 9.6 Solve the problems on shear stress developed in USD method.

- 9.7 Mention the allowable shear stress for RCC beam (v) and shear stress for concrete (v_c).
- 10 Understand the functions of web reinforcement in RCC beams.**
- 10.1 Define web reinforcement.
- 10.2 Classify web reinforcement with sketches.
- 10.3 Mention the functions of web reinforcement in RCC beams.
- 10.4 Determine the spacing of web reinforcement (vertical & inclined) in WSD method.
- 10.5 Determine the spacing of web reinforcement in USD method.
- 10.6 Determine the portion of the RCC beam requiring web reinforcement.
- 11 Understand the bond stress developed in RCC beams.**
- 11.1 State the meaning of bond stress.
- 11.2 Express the derivation of the formula to determine bond stress developed in RCC beams.
- 11.3 State the allowable bond stress for plain bar and deformed bar in WSD and USD methods.
- 11.4 Determine the anchorage length of reinforcement in RCC.
- 11.5 Explain the necessity of standard hooks of reinforcement in RCC.
- 12 Understand the design of RCC rectangular beam in WSD method.**
- 12.1 Outline the design steps of RCC rectangular beam in WSD method.
- 12.2 State the minimum spacing of reinforcing bars in RCC beam.
- 12.3 Design a simply supported RCC rectangular beam in WSD method.
- 12.4 Design a semi-continuous RCC rectangular beam in WSD method.
- 12.5 Design a continuous RCC rectangular beam in WSD method.
- 13 Understand flexure formula in ultimate strength design (USD) method.**
- 13.1 Differentiate WSD and USD method.
- 13.2 Explain the stress diagram of loaded beam with showing the actual & equivalent rectangular stress distribution of ultimate load.
- 13.3 State the load and load factors used in USD method.
- 13.4 Mention the notations used in flexure formula in USD method.
- 13.5 Express the derivation of the flexure formula in USD method.
- 13.6 Solve problems of flexure formula based on USD method.
- 14 Understand the design of RCC rectangular beam in USD method.**
- 14.1 Outline the design steps of RCC rectangular beam in USD method.
- 14.2 Design a simply supported RCC rectangular beam in USD method.
- 14.3 Design a semi-continuous RCC rectangular beam in USD method.
- 14.4 Design a continuous RCC rectangular beam in USD method.
- 15 Understand the design of RCC cantilever & overhanging rectangular beams in WSD method.**
- 15.1 Determine the design load, shear force and bending moment of RCC cantilever & overhanging beams.
- 15.2 Design a cantilever RCC rectangular beam.
- 15.3 Design an overhanging RCC rectangular beam.
- 15.4 Describe the technique of curtailment of reinforcement in cantilever RCC beams.
- 16 Understand the T-beam and its uses.**
- 16.1 Define T-beam.
- 16.2 Identify the different parts of a typical T-beam.
- 16.3 Determine the width of flange of T-beam considering span length and slab thickness.
- 16.4 State the ratio of width of web to the depth of web for T-beams.

- 16.5 Distinguish between RCC rectangular beam and T-beam.
- 17 Understand the design of RCC T-beams.**
- 17.1 Determine the depth and width of a simply supported T-beam in respect to shear force.
- 17.2 Outline the design steps of RCC T-beam in WSD method.
- 17.3 Design a simply supported RCC T-beam in WSD method.
- 17.4 Design a semi-continuous RCC T-beam in WSD method.
- 17.5 Design a continuous RCC T-beam in WSD method.
- 18 Understand the design of RCC beam with compression reinforcement.**
- 18.1 State the meaning of double reinforced beam.
- 18.2 Differentiate between RCC single and double reinforced beam.
- 18.3 Outline the design steps of double reinforced beam.
- 18.4 Design a simply supported double reinforced beam.
- 18.5 Design a semi-continuous double reinforced beam.
- 18.6 Design a continuous double reinforced beam.
- 19 Understand the design of RCC lintel over doors & windows.**
- 19.1 Determine the area of the wall to be considered in determining the design load for RCC lintels.
- 19.2 Outline the design steps of RCC lintel.
- 19.3 Design a RCC lintel over doors and windows.

Practical:

- 1. Conduct compression test of concrete for particular proportion with different water-cement ratio.**
 - 1.1 Mix concrete with different water-cement ratio.
 - 1.2 Fill in the mould (cylinder and cube).
 - 1.3 Keep cylinder and cube in the water for curing.
 - 1.4 Test the specimen in the compression test machine.
 - 1.5 Take the readings and tabulate in the form (test report).
 - 1.6 Calculate the ultimate and allowable compressive strength of concrete.
- 2. Conduct tensile strength test of mild steel for both plain bar and deformed bar of different diameters.**
- 3. Prepare a model of simply supported RCC rectangular beam as per drawing.**
- 4. Prepare a model of semi-continuous RCC rectangular beam as per drawing.**
- 5. Prepare a model of continuous RCC rectangular beam as per drawing.**
- 6. Prepare a model of double reinforced simply supported rectangular beam as per drawing.**
- 7. Prepare a model of RCC lintel as per drawing.**
- 8. Prepare a model of RCC lintel with sunshade as per drawing.**

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4. R C C Design
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AIMS

- To be able to understand the estimating of framed structure multi-storied building.
- To be able to understand the estimating of roof truss, bridge & culvert and deep tube well.
- To be able in preparation of the specification and tender documents of civil engineering works.
- To be able to understand the public works account and forms.
 - To be able to improve knowledge and skill of rate analysis process for different items of work in building construction as per PWD standard.
 - To be able to understand the valuation property and building.

SHORT DESCRIPTION

Complete estimate of multi-storied framed structure building ;/C Sanitary works; Culvert & Bridge; Reinforced cement concrete retaining wall; Roof truss; Stanchion; Deep tube well; Preliminary estimate for building project work according to plinth area rate; Tender documents; Specification; Contracts; Public works account and forms, rate analysis and valuation of property. Bar schedule of beam, column, one way & two way slab.

DETAIL DESCRIPTION

Theory:

MULTI- STORIED FRAMED STRUCTURE BUILDING

1 Understand the components of Multi- storied framed structure building.

- 1.1 Define framed structure building.
- 1.2 Define substructure and superstructure of a building.
- 1.3 Differentiate between structural and non-structural member in a framed structure building.

2 Understand the units of different items of works.

- 2.1 Mention the units of the following item of works:
 - a. earth work in excavation and filling
 - b. brick flat soling
 - c. mass concrete work
 - d. RCC works
 - e. brick work
 - f. plaster and pointing work
 - g. patent stone and DPC
 - h. mosaic and tiles work
 - i. wood works
 - j. lime terracing and water proofing on roof
 - k. white washing, color washing, distempering

I. painting and varnishing

3 Understand the earth work in foundation and plinth.

- 3.1 State the way of calculating earth work in excavation for foundation trenches.
- 3.2 State the way of calculating earth work in filling of foundation trenches.
- 3.3 State the way of calculating earth work in filling plinth for rooms and verandah.

4 Understand the brick flat soling and mass concrete work.

- 4.1 State the way of calculating brick flat soling in foundation.
- 4.2 State the way of calculating brick flat soling in floors.
- 4.3 State the way of calculating mass concrete work in foundation.
- 4.4 State the way of calculating mass concrete work in floors.

5 Understand the reinforced cement concrete work in different items of building

- 5.1 State the meaning of centering and shuttering.
- 5.2 State the method of calculating reinforced cement concrete work in different types of columns.(i.e square,L- shaped,T- shaped I-shaped and circular section column with block,sloped and spread footings,quantity of reinforcement l/c bar schedule and formworks.
- 5.3. State the method of calculating reinforced cement concrete work in all types of beam /lintels, quantity of reinforcement l/c bar schedule and formworks.
- 5.4 State the method of calculating reinforced cement concrete work in one way and two way slab, cantilever and porch slab, quantity of reinforcement l/c bar schedule and formworks.
- 5.5 State the method of calculating reinforced cement concrete work in sun shed, shelves, railing, drop wall,etc in sqm.
- 5.6 State the method of calculating reinforced cement concrete work in stair case. quantity of reinforcement l/c bar schedule and formworks.
- 5.7 State the necessity of cover in RCC works and its limit.

6. Understand the brick work in foundation and superstructure.

- 6.1 Mention the unit of brick work (half brick thick wall) in partition walls.
- 6.2 State the method of calculating brick work in plinth wall.
- 6.3 State the method of calculating brick work (one brick thick wall) in super structure.
- 6.4 State the method of calculating brick work (half brick thick wall) in partition walls.
- 6.5 Define curtain wall and its different components.

7 Understand the cement plaster work.

- 7.1 State the method of calculating cement plaster work on inner side of brick wall.
- 7.2 State the method of calculating cement plaster work on outer side of brick wall.
- 7.3 State the method of calculating cement plaster work on reinforced cement concrete surfaces such as column, lintel, beam, ceiling, sun shed, shelve, railing, drop wall, fins or louvers and stair case etc.

8 Understand the wood work in different types doors and windows.

- 8.1 Mention the unit of wood works in door and window shutters.

- 8.2 State the method of calculating wood work in door frames.
- 8.3 State the method of calculating wood work in door shutters.
- 8.4 State the method of calculating wood work in window frames.
- 8.5 State the method of calculating wood work in window shutters.
- 8.6 State the method of calculating the steel/aluminium frame and shutters of doors and windows i/c glass fibre shutter.

9 Understand the grill works.

- 9.1 Mention the unit of grill works.
- 9.2 State the method of calculating grill works in windows.
- 9.3 State the method of calculating quantity of M.S flat bar, angle bar etc of grill work as per detail drawings.

10 Understand the patent stone flooring, mosaic work, tiles & skirting.

- 10.1 State the method of calculating patent stone flooring.
- 10.2 State the method of calculating tiles work in floor and wall.
- 10.3 State the method of calculating mosaic work on toilet floor.
- 10.4 State the method of calculating mosaic work/tiles on toilet wall.
- 10.5 State the method of calculating skirting work.

11 Understand the lime terracing work over roof slab.

- 11.1 State the method of calculating lime terracing work.
- 11.2 State the method of providing necessary slope to desired directions.
- 11.3 State the method of providing ghundi or hallor.
- 11.4 List the materials required for lime terracing work.

12 Understand the surface finishing works of building.

- 12.1 State the method of calculating white wash (inside only).
- 12.2 State the method of calculating color wash (outside only).
- 12.3 State the method of calculating distemper (inside only).
- 12.4 State the method of calculating plastic emulsion paint (mostly used inside only).
- 12.5 State the method of calculating snowcem wash or weather coat (mostly used outside only).

13 Understand the painting/varnishing to doors & windows.

- 13.1 State the method of calculating synthetic enamel paint to doors and windows.
- 13.2 State the method of calculating synthetic enamel paint to grills.
- 13.3 State the method of calculating synthetic enamel paint to skirting.
- 13.4 State the method of calculating varnishing / french polish to doors.
- 13.5 State the method of calculating varnishing / french polish to windows.

14 Understand the estimate of septic tank.

- 14.1 State the purpose of septic tank.
- 14.2 State the way of calculating earth work in excavation for septic tank.
- 14.3 State the method of calculating brick work in septic tank.
- 14.4 State the method of calculating RCC work in septic tank.
- 14.5 State the method of calculating cement plaster work in septic tank.
- 14.6 State the method of calculating earth filling work in septic tank.

15 Understand the estimate of soak well.

- 15.1 State the purpose of soak well.
- 15.2 State the way of calculating earth work in excavation for soak well.
- 15.3 State the method of calculating brick work in soak well.
- 15.4 State the method of calculating RCC work in soak well.

16 Understand the estimate of RCC slab culvert.

- 16.1 State the purpose of culvert construction.
- 16.2 State the way of calculating earth work in excavation for foundation trenches of culvert.
- 16.3 State the method of calculating brick flat soling in culvert.
- 16.4 State the method of calculating mass concrete work in culvert.
- 16.5 State the method of calculating brick work in culvert.
- 16.6 State the method of calculating RCC work in culvert.
- 16.7 State the method of calculating cement plaster work in culvert.
- 16.8 State the method of calculating earth filling work in culvert.

17 Understand the estimate of RCC T-beam decking bridge.

- 17.1 State the purpose of bridge construction.
- 17.2 State the way of calculating earth work in excavation for foundation trenches of bridge.
- 17.3 State the method of calculating brick flat soling in bridge.
- 17.4 State the method of calculating mass concrete work in bridge.
- 17.5 State the method of calculating brick work in bridge.
- 17.6 State the method of calculating RCC work in bridge.
- 17.7 State the method of calculating cement plaster work in bridge.
- 17.8 State the method of calculating earth filling work in bridge.
- 17.9 Compare the advantages and disadvantages of RCC bridge and wooden bridge.

18 Understand the estimate of RCC retaining wall.

- 18.1 State the purpose of retaining wall.
- 18.2 State the way of calculating earth work in excavation for foundation trenches of RCC retaining wall.
- 18.3 State the method of calculating brick flat soling in RCC retaining wall.
- 18.4 State the method of calculating mass concrete work in RCC retaining wall.
- 18.5 State the method of calculating RCC work in RCC retaining wall.
- 18.6 State the method of calculating back filling work in RCC retaining wall.

19 Understand the estimate of roof truss (wooden & steel).

- 19.1 State the purpose of roof truss.
- 19.2 State the way of calculating the quantities of wood required in a roof truss.
- 19.3 State the way of calculating the quantities of steel required in a roof truss.
- 19.4 Mention the standard lapping at end & sides of CI sheet for roofing.
- 19.5 State the way of calculating the quantities of CI sheet for roof covering.
- 19.6 State the way of calculating the quantities of GI ridging.

19.7 State the way of calculating the painting works of roof truss.

20 Understand the estimate of stanchion (vertical iron column).

20.1 State the meaning of stanchion.

20.2 Identify the different components and accessories of stanchion.

20.3 State the way of calculating the quantities of steel(iron) required in stanchion.

20.4 State the way of calculating the quantities of gusset plate, bolts and nuts used in stanchion.

20.5 State the way of calculating the painting work of stanchion.

21 Understand the estimate of sinking deep tube well.

21.1 State the meaning of deep tube well.

21.2 List the various accessories required for sinking a deep tube well.

21.3 Mention the different sections of a deep tube well.

21.4 Describe the step by step procedure reverse circulation method of sinking a deep tube well.

21.5 State the method of calculating the quantities of materials required for a deep tube well.

21.6 State the meaning of commissioning deep tube well.

22. Understand the estimation of plumbing and sanitary works.

22.1 State the method of estimate plumbing and sanitary works.

22.2 Name the different fittings and fixtures required for water supply and sanitary works

22.3 Describe the method of estimation the drainage works of a buildings.

23. Understanding the process of analysis of rates of various items of work as per PWD standard.

23.1 State the requirements of rate analysis

23.2 Mention the important factors that affect the analysis of rates

23.3 Describe the procedure of rate analysis to calculate the rate per unit of the item of works.

23.4 List the quantity of materials and the number of different categories of labor required for the following item of work and analysis the unit rate i/c contractors profit, over head expenses, income tax (IT) and value added tax (VAT) as per PWD standard.

a. Earth work in excavation for foundation trenches.

b. Earth and sand filling in foundation and plinth.

c. one layer brick flat soling in foundation and floor.

d. Cement concrete work (1:3:6) in foundation and floor.

e. Brick work in foundation up to plinth with 1:6 cement mortar.

f. 75 mm thick damp proof course (DPC) in proportion 1 :1.5: 3.

g. Brick work of 250 mm & above thick wall in superstructure with 1:6 and 1:4 cement mortar.

- h. Brick work of 125mm thick wall in superstructure with 1:4 cement mortar.
- l. RCC work in proportion 1:2:4 and 1:1.5:3 i/c shuttering cost (footing, grade beam, column below & above plinth, lintel & tie beam, roof beam, roof slab, Sun shade, railings, drop wall, shelves, parapet & stair slab etc.
- j. Mild steel reinforcement fabrication work in different types of RCC work for one quintal of work.
 - k. Patent stone flooring in proportion 1:1.5:3 with neat cement finish.
 - l. 20 mm thick cement plaster (1:4) with neat cement finish.
 - m. Average 12 mm thick cement plaster (1:6) to brick walls.
 - n. Average 6 mm thick cement plaster (1:4) to RCC surface.
 - o. Lime terracing work with proportion of 2:2:7 over roof slab.
 - p. Teak wooden door frame and 38 mm thick paneled door shutter.
 - q. Aluminum swing door frame and sliding window.
 - r. Steel glazed window shutter with Z- section, T- section, FI bars.
 - s. White washing, color washing, distemping, snowcem washing, plastic emulsion paint, synthetic enamel paint wherever necessary.
 - t. Installation of European type commode & Indian type long pan (WC) with low level flushing tank, bath tub, wash hand basin, sink, squatting & standing urinals.

24 Understand the preliminary estimate for building project work according to plinth area rate.

- 24.1 State the meaning of preliminary estimate.
- 24.2 Mention the basis of calculating preliminary cost estimate of a building project work.
- 24.3 Describe the calculation procedure of preliminary cost estimate for building project work according to plinth area rate.

25 Understand the concept of tender documents.

- 25.1 State the meaning of tender documents.
- 25.2 Mention the characteristics of ideal tender documents.
- 25.3 Explain the following terms used in a tender documents:-

- a. Name of the project and location of the project.
- b. Estimated cost of the project.
- c. Amount of earnest money.
- d. Period of validity of tender.
- e. Period of commencement of work.
- f. Period of completion of the project.
- g. Security deposit
- h. Maintenance period.
- i. Penalty for delay in completion of the work.
- j. Condition of engagement of sub-contractor.
- k. Scope of works.
- l. Time schedule of work.
- m. Progress report of the work. Step by step for running work.

26 Understand the specification of materials & items of work.

- 26.1 State the meaning of specification of materials & items of work.
- 26.2 Mention the different types of specifications.
- 26.3 Describe the process of writing of specification of materials & items of work.

27 Understand the significance of tender and contracts.

- 27.1 Define tender and contracts.
- 27.2 Mention the different types of tender.
- 27.3 State the meaning of scrutiny of tender, acceptance of tender, power of accepting the tender.
- 27.4 Mention the requirements of contracts.
- 27.5 Classify different types of contracts.
- 27.6 List the conditions of contract on the nature of work.
- 27.7 Mention the terms: termination of contract, labour contract, negotiated contract.

28 Understand the meaning of tender notice.

- 28.1 Define tender notice.
- 28.2 Mention the different types of tender notice.
- 28.3 Mention the particulars needed for a tender notice.
- 28.4 State the meaning of comparative statement.
- 28.5 Describe the process of preparing item wise comparative statement of tender.
- 28.6 Mention the advantages of preparing comparative statement.

29 Understand the public works account and forms.

- 29.1 Name different methods of carrying out works.
- 29.2 Explain imprested account.
- 29.3 Describe the master roll part-I and part-II.
- 29.4 Describe the measurement book (MB).
- 29.5 Define bill and voucher.
- 28.6 Preparation of running & final bill.
- 29.7 Describe the mode of payment.
- 29.8 Mention the duties of Sub-Assistant Engineer.
- 29.9 Describe PPA - 2008.

30. Understand valuation of property and building.

- 30.1 state the meaning of valuation of property.
- 30.2 Mention the objects of valuation.
- 30.3 Define the following terms :
 - a. Outgoings (Taxes, Repairs, Management and collection charges, sinking fund, loss and rent. Miscellaneous.)
 - b. Municipal taxes.
 - c. Scrap value.
 - d. Salvage value.
 - e. Market value.
 - f. Book value.
 - g. Rateable value.
 - h. Obsolescence.
 - i. Annuity.
 - j. Capital cost.
 - k. Capitalized value.
 - l. Years purchase (YP).
 - m. Sinking funds
- 30.4 Define the term valuation of building.
- 30.5 Describe the process to determine the cost of construction of a building.
- 30.6 Describe the process of valuation of a building.
- 30.7 Solve the problems related to a building from given data.

Practical:

1 Estimate the earth work in excavation for foundation trenches.

- 1.1 Select a drawing of a two-storied framed structure building.
- 1.2 Determine the length, breadth & height of foundation trenches of columns and bottom of grade beam (if necessary) & verandah walls.
- 1.3 Calculate the quantity of earthwork in excavation in foundation trenches.

2 Estimate the earth work in filling plinth and sides of foundation trenches.

- 2.1 Determine the length, breadth & height of filling in plinth.
- 2.2 Calculate the quantity of earth work in filling plinth.
- 2.3 Calculate the quantity of earth work in filling the sides of column foundation trenches & sides of grade beam (if necessary).

3 Estimate the brick flat soling & mass concrete in foundation and floor.

- 3.1 Determine the length & breadth for brick flat soling in foundation.
- 3.2 Determine the length & breadth for brick flat soling in floor.
- 3.3 Calculate the total quantity of brick flat soling in foundation and floor.
- 3.4 Determine the length, breadth & thickness of mass concrete in foundation.
- 3.5 Determine the length, breadth & thickness of mass concrete in floor.
- 3.6 Calculate the total quantity of mass concrete in foundation and floor.

4 Estimate the reinforced cement concrete work in foundation upto plinth level.

- 4.1 Determine the length, breadth & thickness of column footing.
- 4.2 Calculate the quantity of RCC work in column footing.
- 4.3 Determine the length, breadth & height of column upto plinth level.
- 4.4 Calculate the quantity of RCC work in column upto plinth level.
- 4.5 Determine the length, breadth & depth of grade beam.
- 4.6 Calculate the quantity of RCC work in grade beam.

5 Estimate the reinforced cement concrete work in superstructure.

- 5.1 Determine the length, breadth & height of column in each floor.
- 5.2 Calculate the quantity of RCC work in column in each floor.
- 5.3 Determine the length, breadth & depth of lintel in each floor.
- 5.4 Calculate the quantity of RCC work in lintel in each floor.
- 5.5 Determine the length, breadth & depth of beam in each floor.
- 5.6 Calculate the quantity of RCC work in beam in each floor.
- 5.7 Determine the length, breadth & thickness of floor slab/roof in each floor.
- 5.8 Calculate the quantity of RCC work in floor slab/roof in each floor.
- 5.9 Determine the length & breadth or height of sunshed, shelve, railing, drop wall, fins or louvers in each floor.
- 5.10 Calculate the quantity of RCC work in sunshed, shelve, railing, drop wall, fins or louvers in each floor.
- 5.11 Determine the length, breadth & thickness or depth or height of stair slab, steps, beam, landing slab in each floor.
- 5.12 Calculate the quantity of RCC work in stair slab, steps, beam, landing slab in each floor.
- 5.13 Calculate the quantity of reinforcement in different items building with bar schedule.

6 Estimate the brick work in sub-structure (foundation upto plinth level) and superstructure.

6.1 Determine the length, breadth & height of brick walls upto plinth level.

6.2 Calculate the quantity of brick work in sub-structure.

31

6.3 Determine the length & height of one brick thick walls in superstructure in each floor.

6.4 Calculate the quantity of brick work (one brick thick wall) in super structure in each floor (cum).

6.5 Determine the length & height of partition wall (half brick thick wall) in super structure in each floor.

6.6 Calculate the quantity of brick work (half brick thick wall) in super structure in each floor (sqm).

6.7 Calculate the quantity of curtain wall of a high rise building l/c all accessories with aluminum frame.

7 Estimate the cement plaster work on brick walls.

7.1 Determine the length & height of brick walls (inner side).

7.2 Calculate the quantity of cement plaster on brick walls (inner side).

7.3 Determine the length & height of brick walls (outer side).

7.4 Calculate the quantity of cement plaster on brick walls(outer side).

7.5 Calculate the quantity of deduction for doors, windows and verandah opening.

7.6 Calculate the total quantity of cement plaster on brick walls.

8 Estimate the cement plaster work to RCC surfaces.

8.1 Determine the height & breadth of RCC columns.

8.2 Calculate the quantity of cement plaster on rcc columns.

8.3 Determine the length & breadth of RCC lintels.

8.4 Calculate the quantity of cement plaster on RCC lintels.

8.5 Determine the length & breadth of RCC beams.

8.6 Calculate the quantity of cement plaster on RCC beams.

8.7 Determine the length and breadth of RCC ceiling.

8.8 Calculate the quantity of cement plaster to RCC ceiling.

8.9 Determine the length & breadth or height of sunshed, shelve, railing, drop wall, fins or louvers.

8.10 Calculate the quantity of cement plaster to sunshed, shelve, railing, drop wall, fins or louvers(both sides).

8.11 Determine the length and breadth of RCC soffit in stairs & bottom surface of landing slab.

8.12 Calculate the quantity of cement plaster to RCC stair case.

8.13 Calculate the total quantity of cement plaster to RCC surfaces.

9 Estimate the wood work in door frames and shutters.

9.1 Identify the different sizes of doors.

9.2 Determine the length & sizes of doors (wooden, steel / aluminum) frames.

9.3 Calculate the quantity of wood work in door frames(cum).

9.4 Determine the breadth & height of door shutters.

9.5 Calculate the quantity of door shutters, wooden, steel and glass fiber. (sqm).

10 Estimate the wood & steel work in window frames and shutters.

10.1 Identify the different sizes of windows.

10.2 Determine the length & sizes of window frames.

10.3 Calculate the quantity of wood work in window frames(cum).

10.4 Determine the breadth & height of window shutters.

10.5 Calculate the quantity of window shutters ,wood, steel and glazed shutter,(sqm).

11 Estimate the grill works.

- 11.1 Identify the different sizes of windows.
- 11.2 Determine the breadth & height of window openings.
- 11.3 Calculate the quantity of grill works(sqm).
- 11.4 Determine the breadth & height of verandah openings.
- 11.5 Calculate the quantity of grill works(sqm).

12 Estimate the patent stone flooring, mosaic work, tiles & skirting.

- 12.1 Determine the length & breadth of rooms and verandah for patent stone flooring.
- 12.2 Calculate the quantity of patent stone flooring in each floor.
- 12.3 Determine the length & breadth of rooms for mosaic works.
- 12.4 Calculate the quantity of mosaic works in each floor.
- 12.5 Determine the length & breadth of rooms for tiles work.
- 12.6 Determine the length & height of walls for tiles work.
- 12.7 Calculate the quantity of tiles work in each floor.
- 12.8 Determine the length & height of walls for skirting works.
- 12.9 Calculate the quantity of skirting works in each floor.

13 Estimate the lime terracing over RCC roof slab.

- 13.1 Determine the length, breadth & thickness of lime terracing.
- 13.2 Calculate the quantity of lime terracing.
- 13.3 Find out the quantity of each materials required for lime terracing.

14 Estimate the quantity of white wash, color wash, snowcem wash, distemper, plastic paint where necessary.

- 14.1 Determine the length & breadth or height of walls and ceiling.
- 14.2 Calculate the quantity of area for white washing.
- 14.3 Determine the length & height of outside walls for color wash.
- 14.4 Calculate the quantity of area for color washing.
- 14.5 Determine the length & height of outside walls for snowcem wash.
- 14.6 Calculate the quantity of area for snowcem washing.
- 14.7 Determine the length & breadth or height of walls and ceiling.
- 14.8 Calculate the quantity of area for distemping.
- 14.9 Determine the length & breadth or height of walls and ceiling.
- 14.10 Calculate the quantity of area for plastic emulsion painting.

15 Estimate the painting and varnishing works to doors, windows, grills and skirting.

- 15.1 Identify the different sizes of doors, windows and grills.
- 15.2 Determine the length & height of each type of doors, windows and grills.
- 15.3 Calculate the quantity of area for painting and varnishing.
- 15.4 Determine the length & height of walls for skirting.
- 15.5 Calculate the quantity of area for skirting works.

16 Prepare an estimate of a septic tank with allied connections & fixtures.

- 16.1 Select a detail drawing of septic tank for 100 users.
- 16.2 Determine the necessary dimensions for detail estimate.
- 16.3 Estimate the different items of work of septic tank such as earth work in excavation & filling, brick flat soling, CC & RCC in base & top slab, brick works, cement plaster, patent stone flooring including all fittings.

17 Prepare an estimate of a soak well.

- 17.1 Select a detail drawing of soak well for 100 users.
- 17.2 Determine the necessary dimensions for detail estimate.

17.3 Estimate the different items of work of soak well such as earth work in excavation, RCC in curbs & top slab, solid & honey comb brick works, inside filling including all fittings.

18 Prepare an estimate of a RCC slab culvert.

18.1 Select a detail drawing of RCC slab culvert.

18.2 Determine the length, breadth & height or thickness of different members of the RCC slab culvert.

18.3 Estimate the different items of work of RCC slab culvert such as earth work in excavation & filling, brick flat soling, CC & RCC in base & top slab, brick works, cement plaster etc.

19 Prepare an estimate of a RCC T-beam decking bridge.

19.1 Select a detail drawing of a RCC T-beam decking bridge.

19.2 Determine the length, breadth & height or thickness of different members of the RCC T-beam decking bridge.

19.3 Estimate the different items of work of RCC T-beam decking bridge such as earth work in excavation & filling, brick flat soling, CC & RCC in base, beam & deck slab, brick works, cement plaster etc.

20 Prepare an estimate of a two span box culvert.

20.1 Select a detail drawing of two span box culvert.

20.2 Determine the length, breadth & height or thickness of different members of the two span box culvert.

20.3 Estimate the different items of work of two span box culvert such as earth work in excavation & filling, brick flat soling, RCC in box etc.

21 Prepare an estimate of a wooden bridge.

21.1 Select a detail drawing of a wooden bridge.

21.2 Determine all the necessary measurements of different members of the wooden bridge.

21.3 Estimate the quantity of different items of work in the wooden bridge.

21.4 Calculate the total quantity of wood required.

21.5 Calculate the necessary metal fastening or accessories required.

22 Prepare an estimate of a RCC retaining wall.

22.1 Select a detail drawing of a RCC retaining wall.

22.2 Determine the length, breadth & height or thickness of stem and base of the retaining wall.

22.3 Estimate the quantity of RCC work in stem and base of retaining wall.

22.4 Determine the measurement of reinforcement of the retaining wall.

22.5 Calculate the quantity of reinforcement required for the retaining wall.

23 Prepare an estimate of a wooden truss with CI sheet roofing.

23.1 Select a detail drawing of a king post roof truss.

23.2 Determine the length & sizes of different members of the truss.

23.3 Calculate the quantity of wood required for the truss in cum.

23.4 Determine the measurements of roofing area of the truss.

23.5 Calculate the quantity of CI sheet roofing in bundle / sqm.

23.6 Calculate the quantity of GI ridging in rm.

23.7 Calculate the quantity of painting works of the truss.

24 Prepare an estimate of a steel truss with CI sheet roofing.

24.1 Select a detail drawing of a steel truss.

24.2 Identify the length, sizes & thickness of different members of the truss.

24.3 Determine the measurements of each of the member of the truss.

24.4 Calculate the total quantity of steel required in killogram/quintal/ton.

- 24.5 Determine the measurements of roofing area of the truss.
- 24.6 Calculate the quantity of CI sheet roofing in bundle / sqm.
- 24.7 Calculate the quantity of GI ridging in rm.
- 24.8 Calculate the quantity of painting works of the steel truss.

25 Prepare the cost of abstract of wooden & steel roof truss.

- 25.1 Identify the local rate of timber & other materials and labours for wooden truss.
- 25.2 List the items of work of a wooden truss.
- 25.3 Calculate the cost of abstract for wooden truss as per present market rate.
- 25.4 Identify the local rate of steel & other materials and labours for steel truss.
- 25.5 List the items of work of a steel truss.
- 25.6 Calculate the cost of abstract for steel truss as per present market rate.

26 Prepare an estimate of a stanchion.

- 26.1 Select a detail drawing of a stanchion.
- 26.2 Identify the length, sizes & thickness of different members of the stanchion.
- 26.3 Determine the measurements of each of the member of the stanchion.
- 26.4 Calculate the total quantity of steel required in killogram/quintal/ton.
- 26.5 Calculate the quantity of painting works of the stanchion.

27 Prepare an estimate for sinking a deep tube well.

- 27.1 List the different sections of the deep tube well.
- 27.2 Make a list of different accessories required at the time of sinking of deep tube well.
- 27.3 Identify the standard items of work for sinking a deep tube well.
- 27.4 Determine the necessary measurements of items of work to be done.
- 27.5 Calculate the costing of sinking deep tube well step by step.

28 Prepare a preliminary estimate for a building project work according to plinth area rate.

- 28.1 Identify a building project work.
- 28.2 Study the building project to be done.
- 28.3 Classify the plinth area if necessary.
- 28.4 Determine the actual plinth area of the building project.
- 28.5 Calculate the preliminary costing for the building project according to plinth area rate as determined by a genuine agency.

29 Prepare the detail specification of important building materials.

- 29.1 Identify the different important building materials for writing specification.
- 29.2 Write the detail specification of the important materials such as brick, sand, cement, coarse aggregate, water, mild steel reinforcement, surki, lime, paint, distemper, timber, GI pipes etc.

30 Prepare the detail specification of important items of work of building.

- 30.1 Identify the different items of work of building for writing specification.
- 30.2 Illustrate the different items of work which should be clearly understandable to the supervisor, workmen & contractors.
- 30.3 Write the detail specification of important items of work of building such as earth work in excavating, earth work in filling, brick flat soling, brick work, cement plaster, mass concrete, reinforced cement concrete, test of concrete, form work, curing, lime terracing, white washing, color washing, snowcem washing, plastic painting, enamel painting, wood works in doors & windows, grill works, patent stone flooring, mosaic work, skirting etc.

31 Prepare a sample of tender documents for the construction of a twostoried framed structure building.

31.1 Make the followings:

- a. cover page of the tender documents
 - b. contents belongs the tender documents
 - c. tender notice
 - d. abstract of tender
 - e. instructions to tenderers
 - f. tender form
 - g. specimen of deed of aggrement
 - h. conditions of contract
 - i. detail specifications of materials.
 - j. detail specifications of items of civil work
 - k. detail specifications of items of sanitary & water supply work
 - l. detail specifications of items of electrical work
 - m. detail specifications of items of gas connection work
 - n. schedule of items of works
 - o. abstract of cost
 - p. arrange all the papers and bind the document.
 - q. submit the document to assess by the class teacher.
32. Prepare M. B. for a small construction walls.

REFERENCE BOOKS

1. A Text Book of Estimating and Costing
-by G S Birdie
2. Civil Estimating Quantity Surveying and Valuation
-by Amarjit Agarwal
3. Estimating and Costing
-by S C Rangwala
4. Estimating and Costing in civil engineering theory and practice-by B.N. Dutta
5. Tender documents of any building project prepared by Bangladesh Public Works Department (BPWD) or any other govt. organizations or any reputed civil engineering consulting firms in Bangladesh.

AIMS

- To be able to understand the modern techniques of construction management.
- To be able to understand the organization of contract department, pre-tender and post-tender planning.
- To be able to understand the operational research, site layout and organization.
- To be able to understand the mobilization of materials, equipment and construction safety.
- To be able to understand the quality and cost control.
- To be able to understand the maintenance, planning maintenance, supervision and execution of maintenance work in construction.
- To be able to understand the maintenance problems and its remedial measures.

SHORT DESCRIPTION

Principles of construction management; Organization of contracts department; Pre-tender and Post-tender planning; Public Procurement Rule; Operational research; Site layout and organization; Mobilization of materials and equipment; Safety in construction; Quality and cost control; Nature and importance of construction maintenance; Alteration and improvement of building; Planning maintenance work; Execution of maintenance work; Supervision of maintenance work; Maintenance problems and their solutions.

DETAIL DESCRIPTION**Theory:****1 Understand the principles of construction management**

- 1.1 Define management.
- 1.2 State the functions of management.
- 1.3 Describe the planning and executive functions of management.
- 1.4 Define construction management.
- 1.5 Establish the relation between management. and construction management.
- 1.6 Explain the necessity for scientific management in construction process.
- 1.7 Describe the role of an engineer as a construction manager.
- 1.8 List the organs of project management team (PMT).
- 1.9 State the main objectives of a project management team.

2 Understand the organization of contracts department.

- 2.1 Define organization.
- 2.2 Describe organizational effectiveness in an organization.
- 2.3 State the staffing pattern in an organization of contract department.
- 2.4 Draw an organizational chart of a contracts department.
- 2.5 Describe the responsibilities and authorities of the components of contracts department.

- 2.6 List different government engineering department in Bangladesh.
2.7 Explain the role and responsibilities of the following within the engineering organization:

- i) Chief Engineer (CE)
- ii) Additional Chief Engineer (ACE)
- iii) Superintending Engineer (SE)
- iv) Executive / Divisional Engineer (XEN/DE)
- v) Sub-Divisional Engineer (SDE)
- vi) Asstt. Engineer (AE)
- vii) Sub-Asstt. Engineer (SAE)
- viii) Work Supervisor/Work Assistant.

2.8 Describe the common sections in a divisional office of an engineering department.

- 2.9 Describe the function and objectives of consultants for contracts department.
2.10 Describe different component of Development project proforma / proposal (DPP) of any construction project.

3 Understand the pre-tender planning.

- 3.1 Define pre-tender planning.
- 3.2 State the objectives of pre-tender planning.
- 3.3 List the activities of pre-tender planning.
- 3.4 State the procedural steps of entrusting a work to the contractor.
- 3.5 Define pre-qualification of contractors.
- 3.6 Describe the procedure of preparation of pre-qualification document.
- 3.7 Explain the procedure of preparation of evaluation criteria of pre-qualification document.

4 Understand the post-tender planning.

- 4.1 Define post-tender planning.
- 4.2 List the activities of post-tender planning.
- 4.3 Explain anticipation of award.
- 4.4 Define evaluation of contract.
- 4.5 Explain the silent features of evaluation of contract.
- 4.6 Describe the methods of work planning and management.
- 4.7 Explain construction stage, construction operation and construction schedule.
- 4.8 Describe the preparation of a construction schedule.
- 4.9 Explain the method of calculating project length.
- 4.10 Describe bar chart and its shortcoming and remedies.
- 4.11 State the meaning of the followings:
 - a. Contract
 - b. Tender
 - c. Liquidated damage
 - d. Extension of time
 - e. Termination of contract
 - f. Evaluation of contract
 - g. Force major
 - h. Performance security
 - i. e-Tendering
 - j. Technical Specification
 - k. Working drawing
 - L. Shop drawing.

5 Understand the recent public procurement rules (PPR) implemented by the govt. of Bangladesh.

- 5.1 State the back ground of PPR development in Bangladesh.

- 5.2 State the meaning of the following: PPR, ITT, TDS, GCC, PCC, NOA, BOQ, TEC, TOC, HOPE, CS, OTM, RFQ, DPM, CPTU.
- 5.3 Describe the preparation of standard tender document for works.
- 5.4 Describe the preparation of standard tender document for goods.
- 5.5 Describe the process of tender submission.
- 5.6 Describe the process of evaluation of tender document.

6 Understand the operational research in construction management process.

- 6.1 Define operational research.
- 6.2 State the necessity of network planning.
- 6.3 Classify network planning.
- 6.4 Describe the procedure construction network.
- 6.5 Define critical path method (CPM) and project evaluation & review technique (PERT).
- 6.6 Describe the process of construction CPM network.
- 6.7 Describe the process of drawing a PERT network.
- 6.8 Distinguish between CPM and PERT network.
- 6.9 Explain the following terms:
 - a. Event
 - b. Activity
 - c. Duration
 - d. Dummy activity
 - e. Total float
 - f. Free float

7 Understand the site layout and organization in construction management.

- 7.1 State different features of a site layout plan.
- 7.2 Draw a site layout plan of a construction site organization.
- 7.3 Describe the staffing pattern in site organization.
- 7.4 Draw an organization chart for site office.
- 7.5 Explain the role and responsibilities of the following staff within the organization:
 - a. Resident Engineer/Site Engineer
 - b. Contractor's agent
 - c. Sub-Asstt. Engineer
 - d. Work Assistant
 - e. Security officer and other staff.
- 7.6 Explain the need for liaison and co-operation between site engineer and contractor's agent.
- 7.7 Describe the relation between-
 - a. Site office and Head office
 - b. Contractor and Head office
- 7.8 Explain the importance of site security.

8 Understand the mobilization of materials and equipment in construction management.

- 8.1 Define mobilization of materials and equipment.
- 8.2 Explain the procedure of receiving materials on site.
- 8.3 Draw a line plan of a material warehouse within the site.
- 8.4 Explain the procedure of removing materials from the site.
- 8.5 Classify the movement of materials on construction work.

- 8.6 List different equipment used in the construction process.
- 8.7 State the operation and maintenance of the following:
 - a. Concrete mixer machine
 - b. Concrete hoisting and conveying instrument
 - c. Excavator tractor
 - d. Crawler
 - e. Crane (wheel mounted)
 - f. Vibrator
- 8.8 Explain the following terms:
 - a. Plant history card
 - b. Depreciation
 - c. Plant insurance
- 8.9 Draw a line diagram of a plant shed within the site.
- 8.10 Define resource management.
- 8.11 Explain the significance of resource management in construction.

9 Understand the safety measures to be taken in construction management.

- 9.1 Define safety measure.
- 9.2 State the nature of accidents in construction work.
- 9.3 Describe objectives, application and policy planning of safety program in construction work.
- 9.4 Draw a typical organization chart for safety group.
- 9.5 Describe the responsibility of employers and employees in respect of safety measure.
- 9.6 State the general safety requirements in construction works.
- 9.7 State different signals, signs and tags used in safety work.
- 9.8 Describe necessary safety measure in
 - material handling, storage and disposal,
 - handling of machinery and mechanical equipment and operating motor vehicles.
- 9.9 Explain the necessity of safety training for employees.
- 9.10 Explain the process of preparation of accident report.
- 9.11 Prepare an accident report to the employer.

10 Understand the quality and cost control process in construction management.

- 10.1 Define quality and cost control.
- 10.2 Describe the effects of lack of adequate quality control.
- 10.3 State the effects and benefit of quality control for
 - the contractor,
 - the designer and
 - the consultant.
- 10.4 Draw a flow diagram of a quality plan.
- 10.5 Describe the responsibilities to control the quality of construction of
 - the client,
 - the designer,
 - the manufacturer,
 - the contractor and
 - the supervisor.
- 10.6 Mention the requirements for an effective cost control system.
- 10.7 State the phases of a management cost and control system.
- 10.8 Explain cost reduction cycle.

11 Understand the nature and importance of construction maintenance.

- 11.1 Define maintenance.

- 11.2 Describe the types of maintenance.
 - 11.3 Explain the significance of construction maintenance.
 - 11.4 Explain the magnitude of construction maintenance in our country.
 - 11.5 Describe the liability for defects in construction.
 - 11.6 Explain the importance of considering maintenance implications at Design stage.
 - 11.7 Establish the relation between the capital maintenance and running cost.
- 12 Understand the alteration and improvement of building.**
- 12.1 State the basic criteria for alterations and improvements works.
 - 12.2 List the most common operations in alteration and improvement work.
 - 12.3 Describe the essential basic improvements that are needed in a large number of dwellings in Bangladesh.
 - 12.4 Describe the sequence and management of alteration and improvement work.
 - 12.5 Define rehabilitation and renovation.
 - 12.6 State the advantages of rehabilitation and renovation work.
 - 12.7 Distinguish rehabilitation from alterations and improvements.
- 13 Understand the planning of maintenance work.**
- 13.1 State the need of planning maintenance work.
 - 13.2 Mention the factors to be considered in formulating a maintenance policy.
 - 13.3 List the procedural actions to be followed to outline maintenance policy.
 - 13.4 Explain the nature of planned maintenance.
 - 13.5 Explain the necessity of computerized maintenance program.
 - 13.6 State the need of maintenance manuals.
 - 13.7 Describe the contents of manuals.
- 14 Understand the procedure of execution of maintenance work.**
- 14.1 List the agents usually execute the maintenance work.
 - 14.2 List the variety of ways of notification of defects.
 - 14.3 Explain control card and request card used in execution of maintenance work.
 - 14.4 Define maintenance feedback.
 - 14.5 Explain maintenance feedback and feedback report.
 - 14.6 Describe the components of maintenance procedure.
 - 14.7 Describe the coloured form (Red, White, Blue and Green) used in maintenance activity.
 - 14.8 Describe the necessity of training for manager, supervisor and operatives for effective maintenance.
 - 14.9 Explain the objective, scope and requirements of maintenance incentive scheme.
- 15 Understand the supervision of maintenance work.**
- 15.1 State the main categories of supervisor of works.
 - 15.2 Explain the duties of supervisor.
 - 15.3 Define supervisor's diary with example.
 - 15.4 Explain different types of report.
 - 15.5 Explain the features which should keep in mind during supervision of
 - demolition work,
 - excavation work,
 - conceal work,
 - brick work,
 - roofing,
 - plastering,

- plumbing and
- Drainage work.
- RCC casting

16 Understand different types of maintenance problems and their solution.

- 16.1. Describe the remedial of damage of walls due to settlement.
- 16.2 Explain the process of remedial measure of movement of walls associated primarily with the drying action of tree roots.
- 16.3. Describe the treatments which can be used to repair concrete floor with faulty DPC membrane.
- 16.4 Explain the process of overcoming the efflorescence and stains in brickwork.
- 16.5 Describe different causes of defects in precast concrete cladding and remedial action.
- 16.6 State the causes and remedial measures of the following plastering defects:
 - a. Fine hair crack on the finished plaster
 - b. Loss of adhesion
 - c. Plaster surface sets too quickly
 - d. Plaster surface soft and powdery with very fine crack
 - e. Moisture trapped in new plaster.
- 16.7 Describe the process of repair a patch hole on bituminous pavement.

Practical:

1. Identify the plastering defects in a particular wall and rectify the problem.
2. Identify the efflorescence and stain in a brick wall and rectify the problem.
3. Identify water supply problem in institute building and solve the problem.
4. Identify a sanitation problem in your campus and solve the problem.
5. Draw a neat sketch of a construction site showing different components.
6. Identify patch hole in a bituminous surface and repair it.
7. Identify cracks in concrete floor in a building and repair the cracks.
8. Identify the damaged plaster in a wall of your institute and repair the plaster.
9. Prepare a standard document for construction of raft foundation of a 6-storied residential building following the PPR-2008.
10. Prepare a CPM net work for a given set of data.
11. Prepare a PERT net work for a given a set of data.
12. Prepare a DPP of 6-storied building project for a given a set of data.
13. Prepare an accident report for an accident to the employer.

REFERENCE BOOKS

- 1 Introduction to Building Management (Fifth Edition) -RE Calvert
- 2 Construction Management (Second Edition) -PP Dharwadker
- 3 The Site Agents Hand Book - RHB Ranns
- 4 Building Organization & Procedures (Second Edition) - G Froster
- 4 Building Production and Project Management -R A Burgess and G White
- 5 The Resume of Building Construction & Management with CPM (Construction Concept) -Mohammed Ali Siddiquee
- 6 Project Management, A System Approach to Planning, Scheduling and Controlling (Second Edition). -Harold Kerzner

AIMS

- To be able to understand the standard types of construction used in Bangladesh for road & pavement, bridge & culvert to assess the advantages and disadvantages of each type.
- To be able to understand the procedure, methods & techniques used in construction of road & pavement, drainage system, bridges & culverts, embankment & cuttings.
- To be able to understand the importance of traffic control system.
- To be able to understand the maintenance, servicing & repair procedure, methods & techniques used to keep the highway operational.
- To be able to acquaint with the different aspects of airport construction.

SHORT DESCRIPTION

Modes of transportation and history of road development; Highway planning; Road alignment and survey; Highway geometrics; Subgrade soil; Highway materials, Construction of road formation & classification of road; Low cost road; Water bound macadam road; Bituminous road; Cement concrete road; Hill road; Highway drainage; Traffic control; Road arboriculture; Highway machinery; Highway failures & maintenance; Highway bridges & culverts; Planning of airport; Geometric standard in airport, airport building & warehouses.

DETAIL DESCRIPTION**Theory:****1 Understand the modes of transportation and history of road development.**

- 1.1 Classify transportation.
- 1.2 Explain the importance of transportation.
- 1.3 Mention the benefits of good road system.
- 1.4 Describe in brief the history of road development.
- 1.5 Mention the characteristics of important early roads.
- 1.6 Describe the macadam and telford road construction.

2 Understand the concept of highway planning.

- 2.1 Explain the importance of highway planning.
- 2.2 Mention the objectives of highway planning.
- 2.3 Classify the road according to location & functions:
- 2.4 Mention the objectives of road planning & survey.

3 Understand the concept of alignment of road and survey.

- 3.1 Define alignment of road.
- 3.2 Mention the fundamental principles of alignment of road.
- 3.3 Mention the factors that controls the selection of alignment of road.

- 3.4 Describe the reconnaissance survey for a road construction.
- 3.5 Describe the preliminary survey, final location survey and soil survey for a road construction.
- 3.6 Mention the points to be considered in fixing location of a new urban road.

4 Understand the principles of highway geometric.

- 4.1 Classify the highway geometric into broad categories such as:
 - a) Cross-sectional elements (camber, super elevation)
 - b) Visibility
 - c) Horizontal / Vertical curves
 - d) Road intersections
- 4.2 State the meaning of friction.
- 4.3 Mention the factors that affect friction of coefficient.
- 4.4 Define the terms skid and slip.
- 4.5 Describe the factors that affect the highway geometrics.

5 Understand the concept of highway cross-section.

- 5.1 State the meaning of right of way.
- 5.2 Mention the factors on which the width of pavements depend.
- 5.3 State the terms in relation to road construction: formation width, side slope, berm, embankment, cutting, shoulder, carriage way width, footpath, cycle track, parking lanes, median strip, kerb.
- 5.4 State the meaning of camber.
- 5.5 Explain the necessity of camber.
- 5.6 Describe the procedure of providing camber in road.

6 Understand the concept of sight distance.

- 6.1 State the reaction time and reaction distance.
- 6.2 State the braking time and braking distance.
- 6.3 Classify the various types of sight distances.
- 6.4 Describe each type of sight distances.
- 6.5 Solve problems on stopping sight distance and passing sight distance.

7 Understand the concept of curve ,super elevation and gradient.

- 7.1 State the meaning of curve.
- 7.2 Classify the various type of curves used in highway.
- 7.3 Mention the reasons for extra widening of road on curve.
- 7.4 State the meaning of super elevation.
- 7.5 Describe the method of providing super elevation on site.
- 7.6 Solve the problems on super elevation.
- 7.7 State the meaning of gradient.
- 7.8 Classify the various types of gradient.
- 7.9 Mention the factors on which the gradient of a road depend.
- 7.10 Describe the methods of fixing grade line on site.

8 Understand the concept of highway intersections.

- 8.1 Define intersection of roads.
- 8.2 Mention the purposes of intersection of roads.

- 8.3 Classify the level intersection of roads.
- 8.4 Mention the advantages and disadvantages of each type of intersections and grade separations.
- 8.5 Define underpass and Overpass .

9 Understand the characteristics of sub-grade soil of highway.

- 9.1 Define the term sub-grade in highway.
- 9.2 Describe the characteristics of different sub-grade soil.
- 9.3 Mention the suitable sub-grade for various types of highway construction.
- 9.4 Describe the procedure of improving sub-grade soil for road construction.
- 9.5 Describe construction of road in water logged area.

10 Understand the characteristics of different materials suitable for highway construction.

- 10.1 Mention the advantages and limitations of aggregates for highway construction.
- 10.2 List the tests required for aggregates used for highway construction.
- 10.3 Describe different types of bituminous materials for road construction.
- 10.4 State the properties of bituminous materials.
- 10.5 List the standard tests on bituminous materials.

11 Understand the concept of road formation and classification of roads.

- 11.1 Describe the procedure of earth work in cutting , filling and compaction of soil..
- 11.2 Describe the turving used in road embankment.
- 11.3 List the field tests needed to find out the good quality of compaction of soil for road construction.
- 11.4 Classify the road on the basis of materials, volume of traffic, type of traffic, number of lanes, direction of movement of traffic, area they traverse, cost of roads and rigidity of roads.
- 11.5 Mention the factors influencing the selection of types of base and surfacing of road.

12 Understand the construction of low cost road.

- 12.1 Classify the various types of low cost roads.
- 12.2 Describe the construction procedure of earthen road.
- 12.3 Describe the construction procedure of gravel road.
- 12.4 Describe the construction procedure of soil stabilized road.

13 Understand the construction of Water Bound Macadam (WBM) road.

- 13.1 Define water bound macadam road.
- 13.2 Describe the preparation of sub-grade for construction of WBM road.
- 13.3 Describe the spreading of coarse aggregate for construction of WBM road.
- 13.4 Describe the spreading of fillers in the construction of WBM road.
- 13.5 Describe the method of rolling the road in the construction of WBM road.
- 13.6 Describe the finishing of the surface and shoulders in the construction of WBM road.
- 13.7 Mention the advantages and disadvantages of WBM road.

14 Understand the construction of Bituminous road.

- 14.1 Define bituminous road.
- 14.2 Classify the different types of bituminous road.
- 14.3 List the materials used in the bituminous pavement.
- 14.4 Describe the specification of the materials used for bituminous pavement.
- 14.5 Describe the construction procedure of bituminous road.
- 14.6 Define the seal coat, tack coat and prime coat.
- 14.7 State the terms bituminous carpet, bituminous concrete, sheet asphalt and mastic asphalt.
- 14.8 Mention the advantages and disadvantages of bituminous road.

15 Understand the construction of Cement Concrete road.

- 15.1 Describe the construction procedure of cement concrete (CC), submergible Road in hoar areas and reinforced cement concrete (RCC) road.
- 15.2 List and explain the joints for CC and RCC road with their specification and sketches.
- 15.3 Describe joint fillers & sealers in CC road and RCC road.
- 15.4 Mention the functions of reinforcement & dowel bars in CC and RCC road.
- 15.5 Mention the advantages & disadvantages of CC and RCC road.
- 15.6 Distinguish between flexible and rigid pavement.

16 Understand the concept of hill road.

- 16.1 Mention the special points to be considered for alignment of hill road.
- 16.2 Define the terms: village path or track, bridle path, motor road, hill road, salient curves, re-entrant curve, hair pin bend, corner bend, trace cut.
- 16.3 State the meaning of retaining wall and breast wall.
- 16.4 Mention the causes of land slide.
- 16.5 Mention the preventive measures of land slide.

17 Understand the concept of highway drainage.

- 17.1 Mention the requirements of highway drainage.
- 17.2 Mention the factors which control the design of highway drainage system.
- 17.3 Mention the effects of improper drainage.
- 17.4 Describe the highway drainage system.
- 17.5 Classify the highway drainage.
- 17.6 Define cross-drainage work.
- 17.7 Classify cross-drainage works.

18 Understand the concept of traffic signs.

- 18.1 Classify the different types of traffic signs.
- 18.2 Explain the importance of traffic signs.
- 18.3 Mention the utility of traffic studies.
- 18.4 Mention the utility of traffic regulations.
- 18.5 Mention the utility of traffic signs.

19 Understand the concept of road arboriculture.

- 19.1 State the meaning of arboriculture.
- 19.2 Explain the purpose of plantation on road sides.
- 19.3 Describe the process of tree planting, pattern of tree planting and protection of trees on road sides.

19.4 Mention the advantages and disadvantages of trees on road sides.

20 Understand the machineries used for construction of roads & highways.

20.1 List the machineries used for cleaning the site, earth cutting, earth removing, consolidating and grading in highway construction.

20.2 List the machineries used for crushing road metals.

20.3 List the machineries used for construction of bituminous road.

20.4 List the machineries used for construction of CC & RCC road.

21 Understand the causes of failures of roads & highways.

21.1 Describe the sub-grade, base and wearing course failures.

21.2 Mention the typical failures of flexible pavement.

21.3 Mention the causes of failures of CC & RCC road.

21.4 Mention the typical failures of CC & RCC road.

22 Understand the maintenance of highway.

22.1 Explain the significance of routine maintenance of highways.

22.2 Classify the maintenance work of road.

22.3 Describe the maintenance of

(a) Earthen road.

(b) Water bound macadam road.

(c) Bituminous road.

(d) CC & RCC road.

22.4 Mention the causes for corrugations and wavy surfaces.

22.5 Mention the remedies for corrugations and wavy surfaces.

23 Understand the highway bridges & culverts.

23.1 Distinguish between bridge and culvert.

23.2 Mention the ideal site for construction a bridge or culvert in roads & highways.

23.3 Classify the different types of bridges and culverts.

23.4 Mention the factors which effects the choice & type of bridge or culvert.

23.5 Define the terms: flood discharge, waterway, scouring depth, free board in the construction of bridges & culverts.

23.6 Explain the necessity of repair and maintenance of bridges & culverts.

24 Understand the concept of planning of airport.

24.1 Mention the information required for planning of an airport.

24.2 Mention the points to be considered in selecting the site for an airport.

24.3 Describe the terms: landing strip, approach zone, running lengths & hanger.

24.4 Classify different types of airport.

25 Understand the standard of geometrics used in airport.

25.1 Explain the terms: runway, taxiway, aprons, runway orientation, pattern & grade.

25.2 Distinguish between runway and taxiway.

25.3 State the meaning of heliport.

25.4 Mention the functions of terminal building.

25.5 Distinguish between heliport and airport.

26 Understand the concept of airport building & warehouse.

- 26.1 Mention the functions of airport building.
- 26.2 Mention the facilities to be provided in airport building.
- 26.3 State the meaning of warehouse.
- 26.4 State the importance of warehouse.

Practical:

- 1. Setting an alignment of a new road.
- 2. Prepare the model of a typical clover leaf pattern of grade separation.
- 3. Perform crushing strength test of coarse aggregate used in road construction.
- 4. Perform abrasion test of coarse aggregate used in road construction.
- 5. Perform water absorption, specific gravity and density test of coarse aggregate used in road construction.
- 6. Perform the California Bearing Ratio (CBR) test.
- 7. Perform the aggregate impact value test.
- 8. Perform the test of grading of coarse aggregate.
- 9. Perform the following test for bitumen.
 - a. Loss of ignition
 - b. Softening point
 - c. Fire point.
 - d. Flash point
 - e. Marshal test
- 10. Prepare the models of different types of traffic signs.
- 11. Average Daily traffic (ADT) survey in a busy road intersection.
- 12. Visit of a Fly Over/Overpass/Underpass/intersection/grade separation.
- 13. Visit of an International Airport.

REFERENCE BOOKS

- 1. Highway Engineering -by Gur Charan Singh
- 2. A text book on Highway Engineering and Airports
-by S B Sehgal & K L Bhanot
- 3. Highway Engineering -by S C Rangwala
- 4. Highway and Airport Engineering -by V B Priyani

AIMS

- To be able to develop the working condition in the field of industrial or other organization.
- To be able to understand develop the labor management relation in the industrial sector.
- To be able to develop the management techniques in the process of decision making.
- To be able to manage the problems created by trade union.
- To be able to understand the network , PERT, CPM & MBO
- To be able to perform the marketing.
- To be able to maintain inventory.

SHORT DESCRIPTION

Basic concepts of management; Principles of management; Scientific management; Organization; Span of supervision; Motivation; Personnel management and human relation; Staffing and manpower planning ; Training of staff; Industrial dispute; Concept of leadership; Concepts and techniques of decision making; Concept of trade union; Inventory control; Economic lot size ; Break even analysis; Labour and industrial law; PERT , CMP ; Network ; Marketing; Production management;

1 Understand the basic concepts & principles of management.

- 1.1 Define management and industrial management.
- 1.2 State the objectives of modern management.
- 1.3 Describe the scope and functions of management.
- 1.4 State the principles of management.
- 1.6 State the activity level of industrial management from top personnel to workmen.
- 1.7 Describe the relation among administration, organization & management.
- 1.8 Define Production Management and functions of Production Management.
- 1.9 Explain the social responsibilities of management.

2 Understand the concept of scientific management.

- 2.1 Define scientific management.
- 2.2 Discuss the basic principles of scientific management.
- 2.3 Explain the different aspects of scientific management.
- 2.4 Discuss the advantages and disadvantages of scientific management.
- 2.5 Describe the difference between scientific management and traditional management.
- 2.6 Describe the following four periods of management thought:
 - (i) pre-scientific management.
 - (ii) scientific management.
 - (iii) human relations
 - (iv) refinement extension and synthesis of management theories and practices.

3 Understand the concepts of organization and organization structure.

- 3.1 Define management organization.

- 3.2 State the elements of management organization.
- 3.3 Discuss the types of organization structure
- 3.4 Describe different forms of organization structure.
- 3.5 Distinguish between line organization and line & staff organization.
- 3.6 Distinguish between line organization and functional organization.
- 3.7 Describe the feature advantages and disadvantages of different organization structure.
- 3.8 Define organizational chart.
- 3.9 Describe the different types of organizational chart.

4 Understand the basic concept of span of supervision.

- 4.1 Define span of supervision and optimum span of supervision.
- 4.2 Discuss the considering factors of optimum span of supervision.
- 4.3 Discuss advantages and disadvantages of optimum span of supervision.
- 4.4 Define delegation of authority.
- 4.5 Explain the principles of delegation of authority.
- 4.6 Explain the terms: authority, responsibility and duties.

5 Understand the concept of motivation.

- 5.1 Define motivation.
- 5.2 Discuss the importance of motivation.
- 5.3 Describe financial and non-financial factors of motivation.
- 5.4 State the motivation process or cycle.
- 5.5 Discuss the motivation theory of Maslows and Harzbergs.
- 5.6 Differentiate between theory-X and theory-Y.
- 5.7 Discuss the relation between motivation and morale.

6 Understand the concept of leadership.

- 6.1 Define leadership.
- 6.2 Discuss the importance and necessity of leadership.
- 6.3 Discuss the functions of leadership.
- 6.4 Identify the types of leadership.
- 6.5 Describe the qualities of a leader.
- 6.6 Distinguish between autocratic leader and democratic leader.

7 Understand the basic concepts and techniques of decision making.

- 7.1 Define decision making.
- 7.2 Discuss the importance and necessity of decision making.
- 7.3 Discuss different types of decision making .
- 7.4 Describe the steps in decision making.

8 Understand the concept of personnel management and human relation.

- 8.1 Define personnel management.
- 8.2 Discuss the importance of personnel management.
- 8.3 Discuss the functions of personnel management.
- 8.4 Define staffing.
- 8.6 Define recruitment and selection of employees.
- 8.7 Describe various sources of recruitment of employees.
- 8.8 Describe the various methods of selection of employees.
- 8.9 Discuss the advantages and disadvantages of internal sources of recruitment.
- 8.10 Discuss the disadvantages of external sources of recruitment.
- 8.11 Define training and orientation of employee.
- 8.12 Discuss the importance and necessity of training.
- 8.13 Discuss the various methods of training of workmen, technicians and

executive personnel.

9. Understand the concept of inventory control

9.1 Define inventory.& inventory control.

9.2 Describe the function of inventory control.

9.3 Discuss the necessity and importance of inventory control.

9.4 Mention the advantages and disadvantages of inventory control.

9.5 Explain the following terms :

- Bin card or Bin tag.
- Purchase requisition.
- Store requisition.
- Material transfer note.
- First in first out (FIFO).
- Last in first out(LIFO).
- PERT
- CPM
- NETWORK
- MBO

10 Understand the concept of economic lot size & break even analysis

10.1 Define economic lot size.

10.2 Discuss the effects of over supply and under supply.

10.3 Describe the method of determination of economic lot size.

10.4 Explain the terms :

- Safety stock
- Determination of safety stock
- Lead time

10.5 Define break even point and break even chart.

10.6 Explain the terms :

- Break even analysis.
- Fixed cost.
- Variable cost.

10.7 Discuss the importance of break even analysis.

10.8 Describe the method of preparing break even chart.

10.9 Describe different methods of break even analysis.

10.10 Draw break even chart in different method.

10.11 Mention the advantages and disadvantages of break even analysis.

11 Understand the concept of Marketing and inventory control

11.1 Define marketing.

11.2 Discuss the function of marketing.

11.3 State the objectives of marketing.

11.4 Explain the terms :

- Brand
- Producer
- Consumer
- Customer
- Copyright
- Trade mark

11.5 Discuss product life-cycle and marketing strategies in different stages of a product life-cycle

11.6 Define purchasing

11.7 Describe the five "R" of purchasing principles

12 Understand the concept of trade union and industrial law

- 12.1 Define trade union.
- 12.2 Mention the objectives of trade union.
- 12.3 Discuss the function of trade union.
- 12.4 Describe different types of trade union.
- 12.5 Mention the names of major trade union in Bangladesh.
- 12.6 Define labour and industrial law.
- 12.7 Discuss the importance of labour and industrial law.
- 12.8 Explain the terms :
 - Factory Act. (1965)
 - Minimum Wage Act (1957).
 - Industrial Disputes Act.
 - Work Men Compensation Act.
 - Trade Union Act.