

BANGLADESH TECHNICAL EDUCATION BOARD

4-YEAR DIPLOMA-IN-ENGINEERING PROGRAM

**REFRIGERATION AND AIR-CONDITIONING
TECHNOLOGY**

SYLLABUS

FIFTH AND SIXTH SEMESTER

4-YEAR DIPLOMA-IN-ENGINEERING PROGRAM
REFRIGERATION AND AIR-CONDITIONING
TECHNOLOGY

FIFTH SEMESTER

Sl. No	Subject Code	Subject Name	T	P	C
1.	3253	Piping and Duct Works	2	3	3
2.	3257	Commercial Refrigeration	2	3	3
3.	3258	Maintenance of RAC Equipment	0	6	2
4.	3259	Cold Storage	1	3	2
5.	3157	Automotive Engine and Systems	2	6	4
6.	2848	Applied Electronics	2	3	3
7.	1551	Book keeping & Accounting	2	0	2
8.	1552	Business Organization	2	0	2
			13	24	21

SIXTH SEMESTER

Sl. No	Subject Code	Subject Name	T	P	C
1.	3260	Advanced Refrigeration and Airconditioning	2	3	3
2.	3262	Transport Refrigeration and Airconditioning	2	3	3
3.	3267	RAC plant Operation	2	3	3
4.	3268	RAC Circuits & Controls-II	2	6	4
5.	3269	Fluid Mechanics and Machineries	3	3	4
6.	1355	Environmental Management	2	0	2
7.	1561	Business Communication	2	0	2
8.	1562	Industrial Management-I	2	0	2
			17	18	23

CONTENT

FIFTH SEMESTER

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2.	3257	Commercial Refrigeration	13
3.	3258	Maintenance of RAC Equipment	18
4.	3259	Cold Storage	21
5.	3157	Automotive Engine and Systems	26
6.	2848	Applied Electronics	32
7.	1551	Book keeping & Accounting	38
8.	1552	Business Organization	41

SIXTH SEMESTER

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2.	3262	Transport Refrigeration and Airconditioning	51
3.	3267	RAC plant Operation	58
4.	3268	RAC Circuits & Controls-II	62
5.	3269	Fluid Mechanics and Machineries	68
6.	1355	Environmental Management	75
7.	1561	Business Communication	83
8.	1562	Industrial Management-I	86

NUMBER DISTRIBUTION

FIFTH SEMESTER

Sl. No	Subject code	Name of the subject	T	P	C	MARKS				Total
						Theory		Practical		
						Cont. assess.	Final exam.	Cont. assess.	Final exam.	
1.	3253	Piping and Duct Works	2	3	3	50	50	30	20	150
2.	3257	Commercial Refrigeration	2	3	3	50	50	30	20	150
3.	3258	Maintenance of RAC Equipment	0	6	2	-	-	60	40	100
4.	3259	Cold Storage	1	3	2	25	25	30	20	100
5.	3157	Automotive Engine and Systems	2	6	4	50	50	60	40	200
6.	2848	Applied Electronics	2	3	3	50	50	30	20	150
7.	1551	Book keeping & Accounting	2	0	2	50	50	-	-	100
8.	1552	Business Organization	2	0	2	50	50	-	-	100
			13	24	21	325	325	240	160	1050

NUMBER DISTRIBUTION

SIXTH SEMESTER

Sl. No	Subject code	Name of the subject	T	P	C	MARKS				Total
						Theory		Practical		
						Cont. assess.	Final exam.	Cont. assess.	Final exam.	
1.	3260	Advanced Refrigeration and Airconditioning	2	3	3	50	50	30	20	150
2.	3262	Transport Refrigeration and Airconditioning	2	3	3	50	50	30	20	150
3.	3267	RAC plant Operation	2	3	3	50	50	30	20	150
4.	3268	RAC Circuits & Controls-II	2	6	4	50	50	60	40	200
5.	3269	Fluid Mechanics and Machineries	3	3	4	75	75	30	20	200
6.	1355	Environmental Management	2	0	2	50	50	-	-	100
7.	1561	Business Communication	2	0	2	50	50	-	-	100
8.	1562	Industrial Management-I	2	0	2	50	50	-	-	100
			17	18	23	425	425	180	120	1150

BANGLADESH TECHNICAL EDUCATION BOARD

4-YEAR DIPLOMA-IN-ENGINEERING PROGRAM

**REFRIGERATION AND AIR-CONDITIONING
TECHNOLOGY**

SYLLABUS

FIFTH SEMESTER

3253	PIPING AND DUCT WORKS	T	P	C	
		2		3	3

AIMS

To provide the students with an opportunity to develop knowledge, skill and attitude in the area of piping and duct work with special emphasis on:

- measurement of airflow and duct pressure
- measurement of losses and method of reducing pressure loss in duct
- duct system and duct design
- duct work and duct insulation
- air distribution in airconditioned space
- piping
- fans & blowers

SHORT DESCRIPTION

Concept of duct; Measurement of airflow; Measurement of duct pressure; Pressure loss in ducts; Method of reducing pressure losses in duct; Duct system; Duct design; Duct work; Duct insulation; Air distribution; Piping of refrigeration and airconditioning plants; Fans and blowers.

DETAIL DESCRIPTION**Theory:**

- 1 Understand the concept of duct.**
 - 1.1 State what is meant by duct.
 - 1.2 Mention the classification of duct.
 - 1.3 Define different types of duct.
 - 1.4 Mention the specific use of different ducts.
 - 1.5 List the duct materials used in airconditioning and ventilating system.
 - 1.6 State what is meant by duct shape.
 - 1.7 Illustrate different duct shape commonly used in airconditioning and ventilating system.
- 2 Understand the measurement of airflow in duct.**
 - 2.1 Describe the methods of measuring airflow in duct.
 - 2.2 State the equation of continuity for duct.
 - 2.3 Express the deduction of formula to calculate continuity for duct.
 - 2.4 State Bernoulli's equation for duct.
 - 2.5 Express the deduction of Bernoulli's equation for duct.
 - 2.6 Solve problems on equation of continuity and Bernoulli's equation.
- 3 Understand the measurement of duct pressure.**
 - 3.1 State what is meant by pressure in duct.

- 3.2 Mention the different duct pressure.
- 3.3 Define the terms : static pressure, velocity pressure and total pressure in a duct.
- 3.4 Describe the methods of measuring static pressure, velocity pressure and total pressure in duct.
- 3.5 Solve problems on static pressure, velocity pressure and total pressure in different units.
- 4 Understand the concept of pressure losses in ducts.**
 - 4.1 List the causes of pressure losses in ducts.
 - 4.2 Describe the pressure loss due to friction in ducts.
 - 4.3 Mention the importance of friction factor for ducts.
 - 4.4 Describe the pressure loss due to sudden enlargement and constructions of duct area.
 - 4.5 Describe the pressure loss at suction and discharge of a duct.
 - 4.6 Describe the pressure loss due to an obstruction in a duct.
 - 4.7 Describe the pressure loss in fittings.
 - 4.8 Explain the variation of pressure losses along a duct.
 - 4.9 Solve the problems on pressure losses in duct.
- 5 Understand the method of reducing pressures losses in duct.**
 - 5.1 Identify the fitting in duct, which change pressure losses.
 - 5.2 Describe the affect of using transition piece instead of sudden change in duct area
 - 5.3 Define the terms radius ratio (RR) and aspect ratio (AR).
 - 5.4 Describe the affect of radius ratio and aspect ratio in ductwork.
 - 5.5 Identify an elbow for a rectangular duct.
 - 5.6 Describe the affect of guide vane and splitters used in duct elbow.
 - 5.7 Mention the key points to be considered for reducing pressure loss when designing duct.
- 6 Understand the duct system.**
 - 6.1 State what is meant by duct system.
 - 6.2 Describe the perimeter duct system.
 - 6.3 Describe the extended plenum duct system.
 - 6.4 Describe the single duct and duel duct system.
 - 6.5 Mention the advantages of duel duct system.
- 7 Understand the duct design.**
 - 7.1 State what is meant by duct design.
 - 7.2 Mention the steps of duct design.
 - 7.3 Describe the common methods of duct design.
 - 7.4 Describe the friction chart for circular duct.
 - 7.5 Mention the recommended duct velocities for various application.
 - 7.6 Express the derivation of formula to calculate equivalent diameter of a circular duct for a rectangular duct.

7.7 Solve problems relating duct design.

8 Understand the ductwork.

8.1 Name the materials from which ducts are made.

8.2 Identify the common sheet metal, duct seams and joint.

8.3 Mention the advantages and disadvantages of the rigid, flexible, rectangular and round duct.

8.4 List the factors for ductwork which should be observed for a satisfactory air distribution.

8.5 Describe the method of branch duct take off.

8.6 Explain the necessity of canvas connection in suction and discharge side of fan.

8.7 Describe the techniques of hanging duct with ceiling.

8.8 Mention the recommended sheet metal thickness for duct.

8.9 Mention the recommended supports and hangers for horizontal ducts.

9 Understand the concept of duct insulation.

9.1 State what is meant by duct insulation.

9.2 Outline the importance of duct insulation.

9.3 Identify the duct insulating material.

9.4 Describe the good characteristics of duct insulating material.

9.5 Mention the physical properties of common insulation materials.

9.6 Mention the recommended thickness of common duct insulating material.

9.7 Describe the laying out duct insulating material.

10 Understand the concept of air distribution.

10.1 Mention the factors to be considered in air distribution system.

10.2 Identify the air diffusion equipment used in air conditioning plants.

10.3 Describe the factors to be considered in air conditioning system balancing.

10.4 Identify the different types of supply air outlet.

10.5 Mention the location of return air opening.

10.6 Describe the method of good air distribution in aircondition rooms.

10.7 Describe the method of blanching of air in conditioned space.

11 Understand the concept of piping in refrigeration and airconditioning plant.

11.1 State the methods of pipe sizing.

11.2 Describe the common method of lying and fabricating large copper piping and steel piping for refrigerant.

11.3 Describe the fabrication and insulation of piping for a central air conditioning plant.

11.4 Identify the fittings and accessories required in piping.

11.5 Describe the pipe hanging method in refrigeration and air conditioning plant.

- 11.6 Describe the procedure of insulating pipes for refrigeration and airconditioning plant.
- 11.7 Mention the importance of U loop or trap in refrigeration piping.
- 11.8 Describe the method of connecting suction and discharge lines for parallel operation of multiple compressors.
- 11.9 Describe pressure drop and effect in discharge Line and suction line.

12 Understand the concept of fans and blowers.

- 12.1 Identify the fans and blowers.
- 12.2 Distinguish between induced draft and force draft fans.
- 12.3 Mention the classification of fans used in refrigeration and air condition.
- 12.4 Identify different types of fan.
- 12.5 Describe the operation of centrifugal fan / blower.
- 12.6 Express the derivation of formula to calculate total power developed by a fan.
- 12.7 State the laws of fan.
- 12.8 Describe the method of selecting fan / blower for air handling unit.

Practical :

- 1 Measure the airflow through duct and compare with the specification of the air handling unit.
- 2 Measure the static pressure, velocity pressure and the total pressure in duct.
- 3 **Study the pressure losses in duct**
 - 3.1 Find the pressure losses in band and elbow of duct of an airconditioning plant.
 - 3.2 Find the pressure loss due to sudden contraction in duct of an airconditioning plant.
 - 3.3 Find the pressure loss due to friction in duct.
- 4 **Study the methods of reducing pressure loss in duct.**
 - 4.1 Measure the pressure loss due to bend without splitter / guide vane in duct.
 - 4.2 Measure the pressure loss due to bend with splitter / guide vane in duct.
 - 4.3 Compare the pressure loss in bend without splitter and with splitter.
- 5 **Study the duct design.**
 - 5.1 Find the duct size for your institute library in equal friction method.
 - 5.2 Find the duct size for institute workshop in velocity reduction method.
 - 5.3 Find the duct size for your institute auditorium by static regain method.
 - 5.4 Find the duct size for your institute computer room by T-method.
- 6. **Study the ductwork.**
 - 6.1 Identify the common sheet to be used for ductwork.
 - 6.2 Identify the conventional duct seams and joints.
 - 6.3 Make a rectangular / square duct.
 - 6.4 Insulate the duct.
- 7. **Study the air distribution system of an airconditioning plant.**

- 7.1 Identify the different types of air terminals of a central air conditioning plant.
- 7.2 Draw the conventional air distribution system for a cenemahall.
- 7.3 Draw the conventional air distribution system for a small office block.
- 8. Study the piping of a refrigeration and airconditioning plant.**
 - 8.1 Draw the piping system of a cold storage.
 - 8.2 Draw the piping system of a central summer airconditioning.
 - 8.3 Draw the piping system for winter heating system.
- 9. Study the fan and blower.**
 - 9.1 Identify the different types of fans and blowers.
 - 9.2 Select an air handling unit for your institute Library / Work shop / Auditorium.
 - 9.3 Test a fan with fan testing rig and draw a fan performance curve.
- 10 Visit a central airconditioning plant and prepare a report on piping, ducting and air distribution system.**
- 11 Visit a cold storage and prepare a report on piping system.**

REFERENCE BOOKS

1. A Text Book of Refrigeration and Airconditioning
– R. S. Khurmi
J. K. Gupta
2. Refrigeration and Airconditioning
– Ballaney
3. Basic Refrigeration and Airconditioning
– P. N. Ananthanarayanan
4. Principle of Refrigeration
– Roy. J. Dossat
5. A Course in Refrigeration and Airconditioning
– S. C. Arora
S. Domkundar
৬. পাইপিং অ্যান্ড ডাক্ট ওয়ার্ক
– মোঃ সোলায়মান

3257 COMMERCIAL REFRIGERATION**TP****C****2****3****3****AIMS**

To provide the students with an opportunity to acquire knowledge, skill and attitude in the area of commercial refrigeration with special emphasis on :

- dispensing unit
- vending machine
- display case
- ice making
- Soda fountain and beverage cooler.
- walk in cooler & reach in cooler
- dehumidifier

SHORT DESCRIPTION

- Pressure type water cooler; Bottle water cooler; Water cooler & warmer; Display freezer; Milk cooler; Vending machine; Open top display case; Closed top display case; Ice cream maker; Ice cube maker; Ice plants; Soda fountain and beverage cooler; Walk in cooler; Reach in cooler; Dehumidifier.

DETAIL DESCRIPTION**Theory :****DISPENSING UNITS****1 Understand the features of water dispensing unit.**

- 1.1 State the purpose of water dispensing unit.
- 1.2 Describe with illustration the refrigeration cycle & water cycle of a pressure type water cooler.
- 1.3 Describe the construction of bottle water cooler.
- 1.4 Describe the operation of bottle water cooler.
- 1.5 Describe the construction of bottle water cooler & warmer.
- 1.6 Describe the operation of bottle water cooler & warmer.
- 1.7 State the specifications of water cooler & warmer.
- 1.8 Describe the construction of operation of a water dispensary.
- 1.9 Mention the advantages and disadvantages of water dispensing unit and water cooler warmer

2 Understand the features of milk dispenser.

- 2.1 State the purpose of milk cooling.

- 2.2 Describe the construction of milk cooler.
- 2.3 Describe the operation of milk cooler.
- 2.4 Explain the refrigeration cycle of a milk cooler with dispenser.
- 2.5 Describe the construction of a milk cooler with dispenser.
- 2.6 Describe the operations of a milk cooler with dispenser.

3 Understand the features of vending machines.

- 3.1 State the purpose of refrigerated vending machine.
- 3.2 Mention the classification of the vending machines.
- 3.3 Describe the refrigeration cycle of vending machine.
- 3.4 Identify the components of a vending machine.
- 3.5 Describe the operation of a vending machine.

DISPLAY CASE

4 Understand the features of display case.

- 4.1 State the purpose of display case.
- 4.2 Name different types of display case.
- 4.3 Identify open top and closed top type display case.
- 4.4 Describe the construction of an open top display case.
- 4.5 Describe the operation of an open top display case.
- 4.6 Describe the construction of a close top display case.
- 4.7 Describe the operation of a close top display case.

ICE MAKING

5 Understand the aspect of ice and ice cream making.

- 5.1 State the necessity of ice making.
- 5.2 List the raw materials required to make ice cream.
- 5.3 Explain the preparation of ice cream.
- 5.4 Describe the storing of ice cream.
- 5.5 Outline the marketing of ice cream.
- 5.6 Describe the process of making ice cubes.

6 Understand the features of ice plants.

- 6.1 Mention the classification of ice plants.
- 6.2 Describe the block ice making.
- 6.3 Explain the brine preparation used in a commercial ice plant.
- 6.4 Mention quality of brine used in a commercial ice plant.
- 6.5 Describe the loading of water and unloading of ice in an ice plant.
- 6.6 Describe the storing of ice.
- 6.7 Mention the purpose of brine agitation or air agitation in Ice block.
- 6.8 Describe the Brine agitation and Air agitation process.

Soda fountain and beverage cooler.

7 Understand the Soda fountain and beverage cooler.

- 7.1 Explain the meaning of soda fountain.
- 7.2 Describe the construction of soda fountain.
- 7.3 Describe the operation of soda fountain.

- 7.4 Show the air distribution cycle of soda fountain.
- 7.5 Explain the meaning of beverage cooler.
- 7.6 Describe the construction of beverage cooler.
- 7.7 Describe the operation of beverage cooler.
- 7.8 Show the air distribution cycle of beverage cooler.

WALK IN COOLER & REACH IN COOLER

- 8 Understand the features of walk in cooler.**
 - 8.1 Explain the meaning of walk in cooler.
 - 8.2 Describe the construction of walk in cooler.
 - 8.3 Describe the operation of walk in cooler.
 - 8.4 Draw the refrigeration cycle of a walk in cooler.
 - 8.5 Show the air distribution cycle of a walk in cooler.
- 9 Understand the features of reach in cooler.**
 - 9.1 State the meaning of reach in cooler.
 - 9.2 Describe the construction of a reach in cooler.
 - 9.3 Describe the operation of a reach in cooler.
 - 9.4 Draw the refrigeration cycle of a reach in cooler.
 - 9.5 Show the air distribution of a reach in cooler.

DEHUMIDIFIER

- 10 Understand the features of dehumidifier.**
 - 10.1 State the purpose of dehumidifier.
 - 10.2 Identify the refrigeration cycle of a portable dehumidifier.
 - 10.3 Describe the construction of dehumidifier with air flow cycle.
 - 10.4 Describe the operation of dehumidifier with air flow cycle.
 - 10.5 Describe the condensate water collection process.
 - 10.6 Differentiate the stationary type dehumidifier with the portable type dehumidifier.
 - 10.7 Mention the function of micro switch of dehumidifier.

COMMERCIAL SYSTEMS

- 11 Understand the features of commercial equipment.**
 - 11.1 Identify the refrigeration equipment used for commercial purpose.
 - 11.2 Mention the specific use of commercial refrigeration equipment.
 - 11.3 Identify the compressors used in commercial refrigeration units.
 - 11.4 Mention the use of each type of compressor in commercial field.
 - 11.5 Identify the types of evaporators and condensers used in commercial refrigeration plants.
 - 11.6 Match the appropriate type of expansion device with different commercial refrigeration units.
 - 11.7 Identify different types of condensing units used in commercial refrigeration.
- 12 Understand the features of commercial units.**
 - 12.1 Describe the self contained through the ceiling commercial unit.

- 12.2 Describe the straddle or plug in commercial units.
- 12.3 Explain with illustration the tandem assembly motor compressor.
- 12.4 Describe the parallel assembly motor compressor.
- 12.5 Describe the defrosting systems used in commercial refrigeration system.
- 12.6 Identify the different types of valves used in commercial refrigeration.
- 12.7 Describe the compressor protective devices (suction line accumulator, hot gas by pass valve, solenoid valves, safety valve, suction line blow coil, electric heater, etc.).

Practical :

- 1 Check the performance of a pressure type water cooler starting current, FLA, the temperature of water after running 30 min and auto operation).
- 2 Check the workability of a bottle cooler.
- 3 Check the workability of a bottle type water cooler and warmer.
- 4 Check the performance of a display freezer.
- 5 Test the workability of a milk cooler.
- 6 Test the workability of a display case.
- 7 Test the work ability of an ice maker.
- 8 Make a technical report after visiting a Block Ice plant.
- 9 Draw a piping diagram of a Block Ice plant.
- 10 Check the performance of a portable dehumidifier.
- 11 Build up a dehumidifier.
- 12 Check the performance of check valve & suction pressure regulator.
- 13 Study the operation of side by side Refrigerator.

3258 MAINTENANCE OF RAC EQUIPMENT

T	P	C	
	0	6	2

AIMS

To provide the students with an opportunity to acquire skill and attitude in the area of repair and maintenance of domestic refrigeration equipment with special emphasis on :

- inspection, servicing, repairing and maintenance of the mechanical refrigerator
- inspection, servicing and maintenance of electrical equipment and components of electrical circuits
- testing, adjusting and replacement of domestic refrigeration equipment & components
- CFCs refrigerant recovery and recycle of faulty domestic refrigeration equipment

SHORT DESCRIPTION

Domestic refrigerator freezer cabinet; Performance of a refrigerator-freezer; Electrical circuits of frosted and non-frost type refrigerator-freezer; Components of the electrical circuits of a domestic refrigerator-freezer; Compressor of domestic refrigerator; Service the domestic refrigerator; Service the chest type freezer; Upright type freezer; Window type airconditioner; Split type airconditioner; CFCs refrigerant recovery and recycling.

- 1 Study the domestic refrigerator freezer cabinet.**
 - 1.1 Check the refrigerator cabinet for door leakage.
 - 1.2 Replace the defective door seal of a refrigerator freezer.
 - 1.3 Adjust / Replace the defective door hinge.
- 2 Study the performance of a refrigerator-freezer.**
 - 2.1 Check the cooling performance of a refrigerator freezer.
 - 2.2 Check the running and off time of a domestic refrigerator-freezer.
 - 2.3 Check starting performance of the compressor.
- 3 Study the electrical circuits of a frost type domestic refrigerator-freezer.**
 - 3.1 Check the continuity of the electrical circuit with test lamp.
 - 3.2 Check the continuity of the electrical circuit with the ohm meter.
 - 3.3 Check the continuity with the proper power supply.
- 4 Study the electrical circuit of a non-frost type domestic refrigerator-freezer.**
 - 4.1 Check the continuity of the electrical circuit with test lamp.
 - 4.2 Check the continuity of the electrical circuit with ohm meter.
 - 4.3 Check the continuity with proper power supply.

- 5 Study the components of electrical circuit of a domestic refrigerator-freezer.**
 - 5.1 Test and check the relay.
 - 5.2 Test and check the thermostat.
 - 5.3 Test and check the capacitor.
 - 5.4 Test and check the timer motor.
 - 5.5 Test and check the defrost thermostat used in non-frost refrigerator-freezer.
 - 5.6 Test and check lamp switch, fan switch and combination switch for fan and lamp.
- 6 Study the hermetic compressor of domestic refrigerator-freezer.**
 - 6.1 Identify the capacity of compressor.
 - 6.2 Perform the pre-replacing work of the compressor.
 - 6.3 Replace the compressor.
 - 6.4 Add the oil to the hermetic compressor if necessary.
 - 6.5 Evaluate the refrigeration system.
 - 6.6 Charge the refrigerator with correct amount of refrigerant.
- 7 Service the domestic refrigerator.**
 - 7.1 Clean the outside and inside of the body of a domestic refrigerator-freezer.
 - 7.2 Clean the open type condenser.
 - 7.3 Clean the evaporator surface.
 - 7.4 Clean the compressor.
 - 7.5 Clean the defrost drain line of the domestic refrigerator-freezer.
 - 7.6 Clean the condensate defrost tray.
- 8 Service the chest type freezer.**
 - 8.1 Clean the freezer cabinet with all other components.
 - 8.2 Perform visual inspection of the chest freezer components.
 - 8.3 Check the electrical circuit and its components.
 - 8.4 Check the performance of the chest type freezer on the basis of (i) Cabinet temperature (ii) Running time (iii) Off time (iv) Starting & running amperage.
- 9 Install and inspect the upright type freezer.**
 - 9.1 Select the place of installation of a upright type freezer.
 - 9.2 Check for connect power supply with safety.
 - 9.3 Install the freezer.
 - 9.4 Start the freezer.
 - 9.5 Check for normal operation of the freezer.
- 10 Repair the window type airconditioner.**
 - 10.1 Replace the burn out compressor motor.
 - 10.2 Install the new compressor motor.
 - 10.3 Evacuate the refrigeration system of window type airconditioner.

- 10.4 Charge correct amount of refrigerant into the window aircooler.
- 10.5 Seal the charging line.
- 11 Service the window type airconditioner.**
 - 11.1 Remove the chassis of window type airconditioner from the cabinet.
 - 11.2 Clean condenser, cooling coil, filter, chassis, blower fan motor with appropriate preventive measure.
 - 11.3 Check capacitor, selector, compressor and blower motor.
 - 11.4 Reinstall the chassis of the window type air cooler.
 - 11.5 Check performance of window type air cooler.
- 12 Install the split type airconditioner.**
 - 12.1 Select the appropriate place for installing indoor and out door unit.
 - 12.2 Install the out door unit of split type airconditioner.
 - 12.3 Install the in door unit of split type airconditioner.
 - 12.4 Connect all necessary piping.
 - 12.5 Make the power supply with the protective device for split type airconditioner.
 - 12.6 Operate the system.
- 13 Study the CFCs refrigerant recovery and recycling.**
 - 13.1 Install a piercing valve in the charging line of a faulty compressor of refrigerator & freezer.
 - 13.2 Recover the refrigerant with a recovery unit from the faulty refrigerator/ freezer.
 - 13.3 Remove the faulty compressor motor.
 - 13.4 Install the compressor motor.
 - 13.5 Charge the refrigerant in the refrigerator freezer.
 - 13.6 Recycling the recovered refrigerant with a recycling unit.
 - 13.7 Reuse the recycling refrigerant.

REFERENCE BOOKS

1. Modern Refrigeration and Airconditioning
 - Althouse/Turnquest/Bracciano
2. Refrigeration and Airconditioning Technology
 - welliam C Whitman
 - William M Johnson

3259 COLD STORAGE

T	P	C	
	1	3	2

AIMS

To provide the students with an opportunity to acquire knowledge, skill and attitude in the area of the cold storage with special emphasis on:

- design features of the cold storage
- construction of the cold storage
- heavy duty compressor, condenser of cold storage
- evaporators used in the cold storage
- refragment charging in the cold storage
- Oil charge, cooling and seperation.
- Food preservation, loading and unloading.

SHORT DESCRIPTION

Concept of cold storage; Design of cold storage; Construction of cold storage; Selection procedure of the cold storage; Starting and shut down methods of the cold storage; Compressor used in cold storage; Construction features of condenser; Construction features of the evaporators; Methods of refrigerant charging, oil charge, oil cooling, oil seperation method, food preservation, product loading and unloading in the cold storage.

DETAIL DESCRIPTION**Theory:**

- 1 Understand the concept of cold storage.**
 - 1.1 State the meaning of cold storage.
 - 1.2 Outline the importance of cold storage.
 - 1.3 Mention the classification of cold storage.
 - 1.4 Describe different types of cold storage.
- 2 Understand the design of the cold storage.**
 - 2.1 Mention the factors to be considered for site selection of a Cold storage (project identification and location).
 - 2.2 Identify the lay out plan of a potato Cold storage .
 - 2.3 Mention the factors to determine the shape and size of Cold storage.
 - 2.4 Calculate the preservation Capacity of a Cold storage.
 - 2.5 What is mean by prefabricated system of cold storage.
 - 2.6 Explain the storage Capacity Calculation of boxed frozen meat in pallets stacks and over head rail system.
 - 2.7 Identify the schematic layout of 1000 ton pallet store.

- 2.8 Colling/Refregeration load calculation of cold storage.
- 2.9 Identify the schematic plan of rail layout.
- 2.10 Describe the selection method of the cold storage machinery.
- 2.11 Identify the flow diagram of cold storage refrigerator equipment.
- 2.12 Draw a cold storage equipment installation diagram using conventional symbol and flow direction with colour code.

3 Understand the construction of a cold storage.

- 3.1 Describe the land development process of a cold storage.
- 3.2 List the materials for the construction of cold storage.
- 3.3 List the insulating materials used in a cold storage.
- 3.4 Describe the insulating materials used in a cold storage.
- 3.5 Mention the characteristic and properties insulating materials for cold storage.
- 3.6 Describe different types of insulation.
- 3.7 Describe how insulating is applied on cold storage walls, ceiling and floor.
- 3.8 Describe the need of vapor seals or vapor barriers.
- 3.9 Solved problems on thermal conduction through insulation and storage capacity of cold storage.

4 Understand the features of heavy duty compressors used in cold storage.

- 4.1 Mention the classification of Heavy Duty Industrial (HDI) compressor used in cold storage.
- 4.2 Describe about the construction of compressor used in Ammonia Refrigeration system.
- 4.3 Differentiate the helocarbon used compressor and amonia used compressor.
- 4.4 Compare merits and demerits of slow speed, medium speed, high speed and super hihg speed compressor.
- 4.5 Describe the coding method of lubrication oil of compressor.
 - (1) By water.
 - (2) By Refrigerant.
 - (3) By Refrigerant and adding siphone trap/Assistant Receiver.
- 4.6 Describe the separation of oil from the ammonia refrigeration system.
 - (1) By Oil sperator.
 - (2) By high pressure (H.P) oil collector.
 - (3) By low pressure (L.P) oil collector.
- 4.7 Describe the oil return method of ammonia used compressor.
- 4.8 Describe the starting and shut down method of a cold storage compressor.

5 Understand the heavy duty industrial refrigeration condenser.

- 5.1 Mention the classification of heavy duty condenser used in the cold storage.

- 5.2 Describe the operation of different types of heavy duty industrial condenser used in the cold storage.
- 5.3 Explain the causes of the wide use of atmospheric type condenser in cold storage of Bangladesh.
- 5.4 Mention the factors to be considered to achieve the maximum efficiency by a atmospheric condenser.
- 6 Understand the construction features of evaporator unit.**
 - 6.1 Mention the classification of evaporator used in the cold storage.
 - 6.2 Describe the construction of different types of evaporators used in the cold storage.
 - 6.3 Describe the defrosting methods of evaporator used in the cold storage.
 - 6.4 Describe the installation methods of evaporator units in the cold storage.
 - 6.5 State the meaning of evaporator TD, air flow, air through, external static pressure (ESP), correction factor, face velocity, fins spacing of evaporator.
- 7 Understand the methods of refrigerant charging in cold storage.**
 - 7.1 Describe the leak testing procedure in a refrigeration system of a cold storage.
 - 7.2 Describe the evacuating procedure of a refrigeration cycle of a cold storage.
 - 7.3 Describe the gas charging procedure in a refrigeration system of a cold storage (With Refrigerant charging station).
- 8 Understand the food preservation in cold storage.**
 - 8.1 Describe the principle of cooling for preservation.
 - 8.2 Explain pre-storage treatment.
 - 8.3 Describe Pre-cooling of food.
 - 8.4 Describe Freezing of food.
 - 8.5 Describe grouping of product.
 - 8.6 Describe storage conditions of food stuffs (product, temperature, humidity and life)
 - 8.7 Describe cold storage operation.
 - 8.8 Describe the product loading and unloading process of cold storage.
 - 8.9 Describe the Ventilation process of cold storage.

Practical :

1. **Visit a cold storage and identify the followings:**
 - i) Components of refrigeration cycle.
 - ii) Components of lubricating system.
 - iii) Components of oil return system.
 - iv) Components of Water flow system.
2. **Visit a cold storage and observe the followings:**
 - 2.1 Starting system of the cold storage..
 - 2.2 Compressor loading and unloading.

- 2.3 Refrigerant feeding system.
 - (1) DX-system.
 - (2) Gravity flooded system.
 - (3) Low pressure receiver with liquid pump.
 - (4) Low pressure receiver with liquid pump and siphon trap/Assistant receiver cooling system.
 - (5) Liquid separation system.
- 2.4 Oil collection system:
 - (1) High pressure oil collector.
 - (2) Low pressure oil collector.
- 2.5 Observe the shutdown procedure of cold storage.
- 3 Visit a cold storage and observe the installation technique of the following components.**
 - i) Compressor motor set.
 - ii) Condenser
 - iii) Receiver
 - iv) Evaporator unit.
 - v) Liquid feeding system.
- 4 Visit a cold storage and observe the following-**
 - i) Purging
 - ii) Condenser cooling system
 - iii) Air change methods
 - iv) Condensate drainage system
 - v) Evaporator defrosting system.
- 5 Visit a cold storage of multiple temperature unit and observe the followings:**
 - i) Suction header.
 - ii) Discharge header.
 - iii) Oil adding and draining system.
 - iv) Compressor cooling system.
 - v) Suction, discharge, oil pressure & temperature.
- 6 Visit a cold storage and list electrical components with specification.**
- 7 Visit a cold storage and prepare log sheet.**
- 8 Make a cold storage model room with appropriate materials and Insulation.**

REFERENCE BOOKS

1. Principle of Refrigeration
– R. J. Dossat

2. Commercial Refrigeration and Airconditioning
– Nelson
3. Refrigeration and Air Conditioning
- Trott. welch.

3157	AUTOMOTIVE ENGINE AND SYSTEMS	T P	C	
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AIMS

To provide the students with an opportunity to acquire knowledge skill and attitude in the area of automotive engine system with special emphasis on:

- working principle of IC engines
- construction of IC engines
- operation of IC engines
- systems of IC engines
- performance of IC engines
- EFI System.

SHORT DESCRIPTION

Concept of automotive engine; Automotive engine dimensions; Stationary IC engine parts; IC engine moving parts; Spark ignition engines; Compression ignition (CI) engine; Fuel system of Spark ignition; Fuel system of diesel engines; Lubricating system of IC engine; Cooling system of IC engine; Ignition system of SI engines; Starting system of IC engines; Performance of IC engine, EFI system.

DETAIL DESCRIPTION**Theory:****CONCEPT OF AUTOMOTIVE ENGINE**

- 1 Understand the concept of automotive engine.**
 - 1.1 State what is meant by engine.
 - 1.2 Mention the classification of engine.
 - 1.3 Distinguish between IC engine and EC engine.
 - 1.4 List the major components of IC engine.
 - 1.5 Outline the importance of IC engine.

AUTOMOBILE ENGINE DIMENSIONS

- 2 Understand the terms and factors related to automotive engine dimension.**
 - 2.1 Define bore, stroke, TDC, BDC, clearance volume, swept volume, compression ration, etc.
 - 2.2 Describe the process of determining compression ratio of an engine.
 - 2.3 Solve problems on CR, piston displacement and clearance volume.

STATIONARY ENGINE PARTS**3 Understand the stationary IC engine parts.**

- 3.1 Identify the stationary engine parts.
- 3.2 Mention the functions of cylinder head, block, crank case, etc.
- 3.3 Describe the construction of cylinder head, block and crank case.
- 3.4 Define mono block and individual block.
- 3.5 Mention the function of cylinder liners.
- 3.6 Distinguish between dry liner & wet liner.
- 3.7 Mention the function of intake and exhaust manifold.
- 3.8 Describe the construction of intake and exhaust manifold.
- 3.9 Mention the functions of bearing and valve guide.
- 3.10 Describe the construction of bearing and valve guide.

MOVING ENGINE PARTS**4 Understand the IC engine moving parts.**

- 4.1 Identify the moving parts of an IC engine.
- 4.2 Mention the function of crankshaft, camshaft, engine valves, piston rings, piston pins, connecting rod, timing gears and fly wheel.
- 4.3 Describe the construction of camshaft, crankshaft, valve, piston, connecting rod and flywheel.
- 4.4 Explain the advantages of piston made of alloy.

SPARK IGNITION ENGINE**5 Understand the spark ignition (SI) engine.**

- 5.1 Describe the 4-stroke of SI engine.
- 5.2 Interpret the 4-stroke events of SI engine with the PV diagram.
- 5.3 Explain the 4-stroke of SI engine with the piston position.
- 5.4 Describe the 2-stroke cycle of SI engine.
- 5.5 Explain the operating principle of 2-stroke cycle SI engine with piston position.
- 5.6 Distinguish between 2-stroke cycle SI engine with 4-stroke cycle of SI engine.
- 5.7 Describe the valve timing diagram of 4-stroke cycle SI engine.

COMPRESSION IGNITION ENGINE**6 Understand the compression ignition (CI) engine.**

- 6.1 Describe the 4-stroke of CI engine.
- 6.2 Interpret the 4-stroke events of diesel engine with the PV diagram.
- 6.3 Explain the 4-stroke CI engine with the piston position.
- 6.4 Describe the operation of 2-stroke CI engine.
- 6.5 Explain the operating principles of 2-stroke cycle CI engine with piston position.
- 6.6 Distinguish between 2-stroke cycle CI Engine and 4-stroke cycle CI engine.

6.7 Describe the valve timing diagram of 4-stroke cycle CI engine.

IC ENGINE SYSTEMS

7 Understand the fuel system of petrol engines.

- 7.1 Mention the function of petrol engine fuel system.
- 7.2 List the different components of petrol engine fuel systems.
- 7.3 Describe the different components of petrol engine fuel system.
- 7.4 List the different components of CNG Fuel systems.
- 7.5 Describe the different components of CNG Fuel system.

8 Understand the fuel system of diesel engines.

- 8.1 Mention the function of diesel engine fuel system.
- 8.2 Mention the classification of diesel engine fuel system.
- 8.3 List the components of different diesel engine fuel system.
- 8.4 Describe the operation of different diesel engine fuel system.

9 Understand the lubricating system of IC engines.

- 9.1 Mention the function of lubricating oil in IC engine.
- 9.2 Outline the importance of lubricating system
- 9.3 Mention the classification of lubricating system.
- 9.4 Describe the operation of different types of lubricating system.

10 Understand the cooling system of IC engine.

- 10.1 State the purpose of cooling system of IC engine.
- 10.2 Mention the classification of cooling system.
- 10.3 Describe the operation of different types of cooling system.

11 Understand the ignition system of SI engines.

- 11.1 Mention the function of ignition system.
- 11.2 Mention the classification of ignition system.
- 11.3 Describe the operation of different types of ignition system.

12 Understand the starting system of IC engines.

- 12.1 State the function of starting system of IC engine.
- 12.2 List the methods of starting system of IC engine.
- 12.3 Describe the different methods of starting system.

ENGINE PERFORMANCE

13 Understand the performance of IC engine.

- 13.1 State what is meant by the performance of engine.
- 13.2 Mention the parameters of the engine performance.
- 13.3 Describe the methods of measuring engine break power.
- 13.4 Express the deduction of formulae to calculate indicated power.
- 13.5 State what is meant by engine efficiency.
- 13.6 Solve problems on engine power & efficiencies.

14 Understand the EFI System.

- 14.1 State what is meant by EFI system.
- 14.2 List main elements of EFI system.
- 14.3 Mention the classification of EFI system.

- 14.4 Mention the function of sensor, actuator and ECU.
- 14.5 List the main sensors and actuators used in EFI system.
- 14.6 State what is meant by stoichiometric ratio.
- 14.7 Describe air induction system of EFI Engine.
- 14.8 Describe the fuel system of EFI system.
- 14.9 State what is meant by GDI system.
- 14.10 Mention the advantages of EFI and GDI system.
- 14.11 Mention difference between carburetor and EFI engine.

Practical

- 1 Identify the general tools and equipment used in automobile shop.
- 2 Identify stationary engine parts of an automobile engine.
- 3 Identify moving engine parts of an automobile engine.
- 4 Observe the operation of 4-stroke cycle petrol engine with the help of a model.
- 5 Observe the operation of 2-stroke cycle petrol engine with the help of a model.
- 6 Observe the operation of 2-stroke cycle diesel engine with the help of a model.
- 7 Observe the operation of 4-stroke cycle diesel engine with the help of a model.
- 8 Study the IC engine components.**
 - 8.1 Identify the engine cylinder block, crankcase & cylinder head with all parts connected there with.
 - 8.2 Identify the piston and connecting rod assembly.
- 9 Study the valve trains.**
 - 9.1 Identify the valve train components of an IC engine.
 - 9.2 Adjust the valve clearance of a typical IC engine.
- 10 Study the lubricating system of IC engines.**
 - 10.1 Identify the pressure feed lubricating system and its components.
 - 10.2 Remove the oil filter and replace it if necessary.
 - 10.3 Check the crankcase oil and fill with proper grade of lub oil.
 - 10.4 Diagnose and rectify the troubles of lubricating system troubles.
- 11 Study the cooling system of IC engine.**
 - 11.1 Identify the air and liquid cooling system components.
 - 11.2 Isolate the fan belt and reinstall it after proper inspection.
 - 11.3 Remove the thermostat from the system and fix up it after servicing.
- 12 Study the fuel system of SI engine.**
 - 12.1 Identify the components of SI engine fuel system.
 - 12.2 Disassemble a fuel pump.
 - 12.3 Assemble a fuel pump after necessary servicing.
 - 12.4 Test the fuel pump.
 - 12.5 Fix up the fuel pump in the system.
 - 12.6 Disassemble the carburetor.
 - 12.7 Assemble the carburetor in sequential order.
 - 12.8 Adjust the carburetor to run on idle speed.

- 13 Study the CI engine injection system.**
- 13.1 Identify the different components of CI engine fuel injection system.
 - 13.2 Remove and replace a high pressure pump from engine.
 - 13.3 Disassemble and assemble the injector.
 - 13.4 Test the injector.
 - 13.5 Set the injection timing of a diesel engine (high pressure pump timing).
- 14 Study the ignition system of a SI engine.**
- 14.1 Make a contact point ignition model on a board.
 - 14.2 Identify the components of contact point ignition system.
 - 14.3 Identify the firing order of an engine.
 - 14.4 Set the ignition timing of a multi cylinder engine.
 - 14.5 Check and adjust the ignition timing of a multi cylinder gasoline engine.
 - 14.6 Perform necessary servicing, repairing and replacement of ignition system.
 - 14.7 Identify the components of a CNG kits.
 - 14.8 Observe the operation of CNG Fuel system.
- 15 Study the starting system of IC engine.**
- 15.1 Start an old model engine by hand cranking process.
 - 15.2 Identify the cranking motor of starting system.
 - 15.3 Identify the components of electric starting motor.
 - 15.4 Remove, inspect and service the components of electric starting system.
 - 15.5 Diagnose and rectify starting system troubles.
- 16 Study the engine measurements and performance.**
- 16.1 Find the break power of an IC engine with the help of dynamometer.
 - 16.2 Perform the Morse test of an IC engine to find the indicated power.
 - 16.3 Find the friction power of an IC engine.
 - 16.4 Find the specific fuel consumption and air consumption of an IC engine with the help of conventional methods.
- 17 Study the EFI system.**
- 17.1 Identify of sensors, actuators and ECU of EFI engine.
 - 17.2 Identify air induction and Fuel system of EFI Engine.

REFERENCE BOOKS

- | | | | |
|---|----------------------|---|----------------|
| 1 | Automotive Mechanics | - | Crouse-Anglin |
| 2 | Automechanics | - | Mitchell |
| 3 | Diesel Mechanics | - | Schulz/Evridge |

4	Automechanics	-	Harold T. Glenn
5	The Automobile Engine	-	William Weistein.
৬	ইঞ্জিন অ্যান্ড দেয়ার সিস্টেমস	-	মোঃ রেদওয়ানুর রহমান

AIMS

- To familiarize with thyristor controlled rectifier.
- To familiarize with multivibrator and IC.
- To provide understanding and skill on inverter and converter.
- To familiarize with flip-flop, counter and register.
- To familiarize with semiconductor memory.
- To provide understanding and skill on A/D and D/A converter.
- To develop comprehensive knowledge about microprocessor.

SHORT DESCRIPTION

Thyristor controlled rectifier; Polyphase rectifier; Multivibrator; ICs; Inverter; Converter, Operational amplifier; Flip-flop; Counter; Register; Semiconductor memory; A/D and D/A converter; Microprocessor.

DETAIL DESCRIPTION**Theory :**

- 1 Understand the features of thyristors as controlled rectifiers in single phase circuit.**
 - 1.1 Identify the various types of phase controlled rectifiers using SCR for resistance and inductive load.
 - 1.2 Explain the operation of phase controlled rectifier circuits with wave shapes and appropriate mathematics.
 - 1.3 Explain the ac phase control circuit using triac.
 - 1.4 Mention the applications of controlled rectifiers and ac phase control circuits in :
 - (i) Illumination circuit.
 - (ii) Temperature control.
 - (iii) Variable speed drives for dc motors & small ac motors.
- 2 Understand the principle of polyphase rectifier circuits.**
 - 2.1 Describe the operation of half-wave and full-wave bridge rectifiers using silicon diodes in polyphase circuits.
 - 2.2 Show the wave forms for the polyphase rectifier circuit.
 - 2.3 List the uses of the polyphase rectifier circuit.
- 3 Understand the features of inverter and converter.**
 - 3.1 Mention the principles of operation of single and three phase inverter.

- 3.2 Mention the principles of operation and application of single phase converter, dual converter and cyclo converter.
- 3.3 State the principles of operation of SMPS and UPS.
- 4 Understand the features of multivibrator circuits.**
 - 4.1 Identify the transistor as an ideal switch using CE output characteristics.
 - 4.2 Calculate the component values (collector and base resistor) for a practical transistor switch.
 - 4.3 Explain the operation of collector coupled aistable, monostable and bistable multivibrator circuit using waveshapes at collector and base terminals.
 - 4.4 Express the deduction of formulae for finding the frequency.
 - 4.5 Explain the triggering techniques for bistable multivibrator using wave shapes (any two methods)
- 5 Understand the features of integrated circuits.**
 - 5.1 Mention the advantages of integrated circuits
 - 5.2 Identify different types of IC.
 - 5.3 Explain the manufacturing process of ICs.
 - 5.4 Mention the difference between analogue and digital ICs.
 - 5.5 Describe the pin diagram of audio and power amplifier ICs (one or two examples).
 - 5.6 Identify the ICs used in AM/FM radios/modulator/demodulator with pin diagram.
 - 5.7 Identify the ICs for function generators.
- 6 Understand the features of timer and voltage regulator ICs.**
 - 6.1 Describe the block diagram of timer IC such as NE 555.
 - 6.2 Mention the working principles of 555 timer as monostable and astable multivibrator
 - 6.3 Describe the operation of three terminal voltage regulator ICs (positive, negative and variable).
- 7 Understand the features of operational amplifiers.**
 - 7.1 Write the specifications of ideal operational amplifier.
 - 7.2 Explain the slew rates, offset null adjustment operation on single power supply of operational amplifier.
 - 7.3 Describe the frequency response of unity gain operational amplifier.
 - 7.4 Mention the applications of operational amplifier as inverter, scale changer, comparator, phase shifter, adder, subtracter, differentiator, integrator, wein-bridge oscillator and ramp generator.
- 8 Understand the features of flip-flop and counters.**
 - 8.1 Describe the operation of flip-flop with waveform and truth table.
 - 8.2 Explain the operation of R-S, D, J-K, T and master slave flip-flop.
 - 8.3 Identify different types of counter.
 - 8.4 Explain the operation of synchronous and asynchronous counters.

- 8.5 Describe the operation of ring, ripple, divided by N and programmable counter.
- 8.6 List the commercial ICs for different counters.
- 9 Understand the features of register.**
- 9.1 State the meaning of the term register.
- 9.2 Identify various types of registers.
- 9.3 Explain the operation of serial in serial/parallel out shift register.
- 9.4 Explain the operation of parallel in serial/parallel shift register.
- 9.5 List the commercial ICs for shift register.
- 10 Understand the features of semiconductor memories.**
- 10.1 Mention the principle of semiconductor memory using shift register.
- 10.2 Distinguish between serial access and parallel access memory.
- 10.3 State the meaning of the terms read and write in memory operation.
- 10.4 Mention the principle of ROM. RAM, PROM, EPROM and EEPROM.
- 10.5 Mention the principle of dynamic RAM.
- 10.6 Describe the matrix organization of RAM.
- 11 Understand the features of D/A and A/D convertors.**
- 11.1 Mention the principle of D/A and A/D conversion.
- 11.2 Describe the operation of weighted resistor D/A converter.
- 11.3 List the types of A/D converter.
- 11.4 Mention the working principles of A/D converter.
- 11.5 Explain the popular methods of D/A converter.
- 12 Understand the features of simple microprocessor (8 bit).**
- 12.1 Mention the operation of microprocessor in microcomputer.
- 12.2 List the standard 8 bit microprocessor.
- 12.3 Mention the functions of various pins of Intel 8085, Z 80, MC 6800 and MC 6502 microprocessor.
- 12.4 Explain the architecture of various microprocessor in decoding and executing instructions.
- 12.5 Mention the functions of various registers in the microprocessors.
- 12.6 Explain the addressing modes of different microprocessor.
- 12.7 Identify the instruction set of Intel 8085 microprocessor.
- 12.8 Explain the timing diagram for executing instructions.
- 12.9 Distinguish among Intel 8085, Z 80, MC 6800 and MC 6502 microprocessors.
- 12.10 Draw the block diagram of 8085 based microcomputer system.
- 12.11 Explain the operation of the microcomputer system.

Practical :

- 1 Construct the single phase controlled rectifier using SCR and UJT relaxation oscillator.**
- 1.1 Select an experiment circuit.

- 1.2 Select the components and required tools and materials.
- 1.3 Connect the circuit as per diagram.
- 1.4 Switch on the power supply and check the connections.
- 1.5 Observe the waveshapes at relevant points of the circuit.

2 Study the operation of three phase bridge rectifier circuit.

- 2.1 Select a circuit.
- 2.2 Select the required materials, tools and equipment.
- 2.3 Build up the circuit as per diagram.
- 2.4 Switch on the power supply and check the connection.
- 2.5 Observe the waveshapes at various points.
- 2.6 Record the voltages.

3 Construct and test a transistor monostable multivibrator for a given trigger signal.

- 3.1 Select an experiment circuit.
- 3.2 Select the required tools and materials.
- 3.3 Build up the circuit as per diagram.
- 3.4 Switch on the power supply.
- 3.5 Input a trigger signal.
- 3.6 Observe the wave shapes at each collector and base.

4 Construct and test the operation of an astable multivibrator circuit.

- 4.1 Select an experiment circuit.
- 4.2 Select the required tools and materials.
- 4.3 Construct the circuit as per supply.
- 4.4 Switch on the power supply.
- 4.5 Observe the wave form at each collector and base.
- 4.6 Observe the effect of changing base resistor and /or coupling capacitors on the frequency of the square wave output.

5 Study the operation of monostable and astable multivibrator circuit using 555 timer.

- 5.1 Select an experiment circuit.
- 5.2 Select the required tools and materials.
- 5.3 Build up the circuit as per diagram.
- 5.4 Observe wave shape at typical points.
- 5.5 Determine the voltages.
- 5.6 Observe the monostable and astable operation.

6 Study the operation of R S, D, J K flip flops.

- 6.1 Select a digital trainer or a bread with required ICs and necessary materials.
- 6.2 Build up the circuit with input switches and output LED displays.

- 6.3 Give all possible input to the circuit.
- 6.4 Observe the outputs from the display.
- 6.5 Prepare truth tables.
- 6.6 Verify with expected result.
- 7 Construct a synchronous binary counter using J K flip-flops .**
 - 7.1 Select a digital trainer or a bread board with the required ICs.
 - 7.2 Build up the circuit for the given counter.
 - 7.3 Observe the output from LED display setting clock speed low.
 - 7.4 Prepare a truth table.
 - 7.5 Verify the results.
- 8 Study the operation of a decade counter using J K flip-flops.**
 - 8.1 Select a digital trainer brad board with required ICs and necessary materials.
 - 8.2 Build up the circuit with output LED display.
 - 8.3 Make clock switch on.
 - 8.4 Observe the output from LED display.
 - 8.5 Verify the truth table.
- 9 Study the 8 bit shift register.**
 - 9.1 Select a digital trainer or a bread board with required ICs and necessary materials.
 - 9.2 Connect the circuit with input switch and output display.
 - 9.3 Prepare and verify the truth tale.
- 10 Construct a 4 bit D/A converter using register ladder network.**
 - 10.1 Select a digital trainer or a bread board with required components, equipment, tools and necessary materials.
 - 10.2 Prepare the circuit for D/A converter.
 - 10.3 Provide a digital input.
 - 10.4 Observe the analog output.
- 11 Study the operation and application of SMPS.**
 - 11.1 Select a SMPS.
 - 11.2 Identify different parts of SMPS.
 - 11.3 Observe the operation of SMPS.
- 12 Study the operation and application of UPS.**
 - 12.1 Select & UPS.
 - 12.2 Identify different parts of UPS.
 - 12.3 Observe the operation and use of UPS.
- 13 Study the operation of a simple computer.**
 - 13.1 Select a simple computer board, power supply and required materials.
 - 13.2 Select a program converted in binary codes.
 - 13.3 Supply power to the board.
 - 13.4 Enter the binary code by input switches.
 - 13.5 Push the switch on.

- 13.6 Observe the result from the output LED's display.
- 14 Study the hardware components of a microprocessor based single board computer.**
- 14.1 Select an Intel 8085 (or any other) microprocessor based computer.
- 14.2 Select necessary tools and equipment.
- 14.3 Identify the processor and IC chips.
- 14.4 Identify the components parts with their code numbers.
- 14.5 Draw the one line diagram connecting various chips with signal flow.
- 14.6 Make a supply to the board and note hardware functions.

REFERENCE BOOKS

- | | | | |
|---|---|---|------------------------------|
| 1 | Electronic Devices and Circuits | – | Jacob Millman and C. Halkias |
| 2 | Introduction to Digital Computer and Applications | – | Malvino |
| 3 | Electronic Devices and Circuits | – | G. K. Mithal |
| 4 | Industrial Electronics | – | G. K. Mithal |
| 5 | Modern Digital Electronics | – | R. P. Jain |

1551 BOOK KEEPING & ACCOUNTING

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AIMS

- To be able to understand the principles and practices of book keeping and accounting.
- To be able to understand the procedures of general accounting, financial accounting and their applications.

SHORT DESCRIPTION

Concept of book keeping and accounting; Transactions; Entry systems; Accounts; Journal; Ledger; Cash book; Trial balance; Final accounts; Cost account & financial accounting; Depreciation; Public works accounts.

DETAIL DESCRIPTION**1 Understand the concept of book keeping and accounting.**

- 1.1 Define book keeping and accountancy.
- 1.2 State the objectives of book keeping.
- 1.3 State the advantages of book keeping.
- 1.4 Differentiate between book keeping and accounting.
- 1.5 State the necessity and scope of book keeping and accounting.

2 Understand the transactions.

- 2.1 Define transactions and business transaction.
- 2.2 Explain the importance of transactions.
- 2.3 Describe the characteristic features of transactions.
- 2.4 Discuss the classification of transaction.
- 2.5 Identify the transaction from given statements stating reasons.

3 Understand the entry system.

- 3.1 State the aspects of transactions.
- 3.2 Define single entry system.
- 3.3 State the objectives of single entry system.
- 3.4 Discuss the disadvantages of single entry system.
- 3.5 Define double entry system.
- 3.6 Discuss the principles of double entry system.
- 3.7 Justify whether double entry system is an improvement over the single entry system.
- 3.8 Distinguish between single entry and double entry system of book keeping.

4 Understand the classification of accounts.

- 4.1 Define accounts.

- 4.2 State the objectives of accounts.
- 4.3 Illustrate different type of accounts with example.
- 4.4 Define "Golden rules of Book keeping".
- 4.5 State the rules for "Debit" and "Credit" in each class of accounts.
- 4.6 Determine Debtor (Dr) and Creditor (Cr.) from given transactions applying golden rules.
- 4.7 Define accounting cycle.
- 4.8 State the different steps of accounting cycle.
- 5 Understand the journal.**
 - 5.1 Define journal.
 - 5.2 State the object of journal.
 - 5.3 State the functions of journal.
 - 5.4 Mention the various names of journal.
 - 5.5 Interpret the form of journal.
 - 5.6 Journalize from given transactions.
- 6 Understand the ledger.**
 - 6.1 Define ledger.
 - 6.2 Interpret the form of ledger.
 - 6.3 State the functions of ledger.
 - 6.4 Distinguish between journal and ledger.
 - 6.5 Prepare ledger from given transactions.
 - 6.6 Explain why ledger is called the king of all books of accounts.
- 7 Understand the cash book.**
 - 7.1 Define cash book (single, double and triple column).
 - 7.2 Explain cash book as both journal and ledger.
 - 7.3 Prepare double column cash book from given transactions showing balances.
 - 7.4 Prepare triple column cash book from given transaction and find out the balances.
 - 7.5 Define petty cash book.
 - 7.6 Prepare analytical and imprest system of cash book.
 - 7.7 Define discount.
 - 7.8 Explain the different types of discount.
- 8 Understand the trial balance.**
 - 8.1 Define trial balance.
 - 8.2 State the object of a trial balance.
 - 8.3 Discuss the methods of preparation of a trial balance.
 - 8.4 Explain the limitations of a trial balance.
 - 8.5 Prepare trial balance from given balance.
- 9 Understand the final accounts.**
 - 9.1 State the components of final account.
 - 9.2 Distinguish between trial balance and balance sheet.

- 9.3 Identify the revenue expenditure and capital expenditure.
- 9.4 Select the items to be posted in the trading account, profit & loss account and the balance sheet.
- 9.5 State the adjustment to be made from the given information below or above the trial balance.
- 9.6 Prepare trading account, profit & loss account and balance sheet from the given trial balance & other information.

10 Understand the cost and financial accounting.

- 10.1 Define financial accounting.
- 10.2 State the objectives of financial accounting.
- 10.3 Define cost accounting.
- 10.4 Discuss the relationship between financial accounting and cost accounting.
- 10.5 State the elements of direct cost and indirect cost.
- 10.6 Prepare cost sheet showing prime cost, factory cost, cost of production, total cost and selling price.
- 10.7 Explain the following terms:

a. Fixed cost	e. Process cost
b. Variable cost	f. Direct cost
c. Factory cost	g. Operating cost
d. Overhead cost	h. Standard cost

11 Understand the depreciation

- 11.1 Define depreciation.
- 11.2 State the objects of depreciation.
- 11.3 Discuss the necessity for charging depreciation.
- 11.4 Describe the different methods of determining depreciation.
- 11.5 Explain the relative merits and demerits of different method of depreciation.

12 Understand the public works accounts.

- 12.1 State the important aspects of public works accounts.
- 12.2 Describe the main features of public works accounts.
- 12.3 Explain "Revenue and Grant".
- 12.4 Define Value Added Tax (VAT)
- 12.5 State the merits and demerits of VAT.
- 12.6 Define bill and voucher.

1552 BUSINESS ORGANIZATION

T	P	C
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AIMS

- To be able to understand the basic concepts and principles of business organization.
- To be able to understand the banking system and insurance policy in Bangladesh.
- To be able to understand the trade system and stock exchange activities in Bangladesh.

SHORT DESCRIPTION

Principles and functions of business organization; Formation of business organization; Purchasing functions and systems; Banking system and its operation; Negotiable instrument; Stock Exchange; Home trade and foreign trade; Insurance; provident fund and benevolent fund.

1 Understand business organization.

- 1.1 Define business.
- 1.2 Mention the objects of business.
- 1.3 Define business organization.
- 1.4 State the principles of business organization.
- 1.5 State the function of business organization.

2 Understand the formation of business organization.

- 2.1 Define soletradership, partnership and joint stock company.
- 2.2 Describe the formation of soletradership, partnership and joint stock company.
- 2.3 Mention the advantages and disadvantages of soletradership, partnership and joint stock company.
- 2.4 Discuss the role of co-operative society (producers co-operative and consumers co-operative) in Bangladesh.

3 Understand the purchasing functions and system.

- 3.1 Define purchasing.
- 3.2 Describe the five R (right quantity, right quality, right time, right price & right source) of purchasing principles.
- 3.3 State the function of purchase.
- 3.4 Discuss the purchasing procedure.

4 Understand the banking system and its operations.

- 4.1 Define bank.

- 4.2 State the service rendered by bank.
- 4.3 Describe the classification of bank in Bangladesh.
- 4.4 State the functions of Bangladesh Bank in controlling money market.
- 4.5 Mention the various name of commercial Bank in Bangladesh and their functions.
- 4.6 Describe the role of “Gramin Bank” in assisting small scale industries.
- 4.7 Mention different types of account operated in a bank.
- 4.8 Mention how different types of bank accounts are opened and operated.
- 5 Understand the negotiable instrument.**
 - 5.1 Define negotiable instrument.
 - 5.2 Discuss the types of negotiable instrument.
 - 5.3 Define cheque.
 - 5.4 Describe different types of cheque.
 - 5.5 Define bill of exchange.
 - 5.6 Define hondi and letter of credit.
- 6 Understand the stock exchange.**
 - 6.1 Define stock exchange.
 - 6.2 State the objects of stock exchange.
 - 6.3 Explain the functions of stock exchange.
 - 6.4 Mention the procedure of membership of stock exchange.
 - 6.5 Discuss the procedure of transaction in stock exchange.
 - 6.6 Explain the stock exchange systems in Bangladesh.
- 7 Understand the home trade.**
 - 7.1 Define home trade.
 - 7.2 State the objects of home trade.
 - 7.3 Define whole sale trade.
 - 7.4 State the functions of whole sale trade.
 - 7.5 Define retail trade.
 - 7.6 State the advantages of retail trade.
 - 7.7 Differentiate between whole sale trade and retail trade.
- 8 Understand the foreign trade.**
 - 8.1 Define foreign trade.
 - 8.2 Mention the advantages and disadvantages of foreign trade.
 - 8.3 Mention the classification of foreign trade.
 - 8.4 Discuss the importance of foreign trade in the economy of Bangladesh.
- 9 Understand the insurance, pension compensation, provident fund and benevolent fund.**
 - 9.1 Define insurance.
 - 9.2 Describe the essential conditions of insurance contract.
 - 9.3 Describe life insurance, marine insurance, fire insurance, re-insurance and premium.
 - 9.4 Discuss the types of insurance.

- 9.5 Distinguish between life insurance and general insurance.
- 9.6 State the pension policy of the government and autonomous bodies.
- 9.7 Explain the features of group insurance system and employees benevolent fund.

4-YEAR DIPLOMA-IN-ENGINEERING PROGRAM

**REFRIGERATION AND AIR-CONDITIONING
TECHNOLOGY**

SYLLABUS

SIXTH SEMESTER

3260 ADVANCED REFRIGERATION AND AIRCONDITIONING

T	P	C
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AIMS

To provide the students with an opportunity to acquire knowledge, skill and attitude in the area of advanced refrigeration and air-conditioning with special compasses on:

- P.H diagram
- compound vapor compression system
- vapor compression systems with multiple evaporators and compressors
- solar heating and cooling
- refrigerants & refrigerant oils
- refrigerant recovery, recycling and reclaim
- heat pump
- heat exchanger
- evaporating cooling systems

SHORT DESCRIPTION

Compound vapor compression system; Vapor compression system with multiple evaporator and compressors; Solar heating systems; Solar cooling systems; Refrigerant; CFCs and environmental friendly refrigerants; Refrigerant oil; Refrigerant recovery, recycling & reclaim; Heat pump; Heat exchanger and Evaporative cooling system, P.H diagram.

DETAIL DESCRIPTION**Theory:**

- 1 Understand the P.H diagram of different Refrigerant of simple Vapor Compression Refrigeration system.**
 - 1.1 State what is meant by P.H diagram.
 - 1.2 Draw a typical P.H diagram.
 - 1.3 Describe the different line and zone of P.H diagram.
 - 1.4 Represent Vapor compression cycle on P.H diagram at different condition.
 - 1.5 Explain P.H chart to determine different value of refrigerant of vapor compression cycle.
 - 1.6 Solved problems with P.H chart of different refrigerant at various condition.

- 2 Understand the compound vapor compression system.**
 - 2.1 State the meaning of compound vapor compression system.

- 2.2 Mention the advantages of compound vapor compression with inter cooler.
 - 2.3 Name the different types of compound vapor compression with inter cooler.
 - 2.4 Describe the two stage compression with liquid inter cooler.
 - 2.5 Describe the two stage compression with water intercooler and liquid subcooler.
 - 2.6 Describe the two stage compression with water inter cooler, liquid sub cooler and liquid flash chamber.
 - 2.7 Describe the three stage compression with water inter cooler.
 - 2.8 Solve problems relating the compound vapor compression system.
- 3 Understand the vapor compression system with multiple evaporators and compressors.**
- 3.1 Outline the importance of vapor compression systems with multiple evaporators and compressors.
 - 3.2 Mention the different types of multiple evaporators and compressors system.
 - 3.3 Describe the multiple evaporators at same temperature with single compressor and expansion valve.
 - 3.4 Describe the multiple evaporators at different temperature with single compressor individual, expansion valve and back pressure valve.
 - 3.5 Describe the multiple evaporator at different temperature with single compressor, multiple expansion and back pressure valve.
 - 3.6 Describe the multiple evaporators at different temperature with individual compressor and individual expansion valve.
 - 3.7 Describe the multiple evaporators at different temperature with individual compressors and multiple expansion valves.
 - 3.8 Describe the multiple evaporators at different temperatures with compound compressor, individual expansion valve and flash inter cooling.
 - 3.9 Describe the cascade system of low temperature refrigeration.
 - 3.10 Solve problems.
- 4 Understand the features of solar heating system.**
- 4.1 State what is meant by solar heating system.
 - 4.2 Mention the types of solar heating.
 - 4.3 Describe the operation of different types of solar heat collection.
 - 4.4 Describe the operation of solar air type heating system.
 - 4.5 Describe the operation of liquid type solar heating system.
- 5 Understand the features of solar cooling system.**
- 5.1 State what is meant by solar cooling system.
 - 5.2 Mention the methods of cooling by using solar energy.
 - 5.3 Describe the operation of the different types of solar cooling system.

- 5.4 Describe the solar heat operated year round airconditioning system.
- 5.5 Describe the operation of a solar heat operated dehumidifier.
- 5.6 Describe the operation of solar operated heat pump system.

6 Understand the features of refrigerant.

- 6.1 Mention the physical properties of an ideal refrigerant.
- 6.2 Mention the chemical properties of an ideal refrigerant.
- 6.3 Mention the thermodynamic properties of an ideal refrigerant.
- 6.4 Mention the classification of the refrigerant.
- 6.5 Describe the properties of refrigerant as halo carbon- R-12, R-22, R-124, R-125, R-134a, zeotropic R-400a to R-416a, Azeotropic refrigerant R-500 to R-507, Hydrocarbon refrigerant R-290, R-600, R-600a and H C blend, inorganic refrigerant R-717, R-718, R-728, R-729, R-740 and R-69s.
- 6.6 Describe the designation system for refrigerants.
- 6.7 Mention the applications of commonly used refrigerants.
- 6.8 Explain the effects of condensing pressure, evaporating temperature, boiling point, critical temperature and specific volume on refrigeration cycle.
- 6.9 Mention the color code of different refrigerant cylinder.
- 6.10 Describe the handling and storage procedure of refrigerant and refrigerant cylinder.
- 6.11 Mention the safety requirement when handling and working with refrigerant.

7 Understand the features of the CFCs and environmental friendly refrigerants.

- 7.1 State what is meant by the CFC.
- 7.2 State what is meant by environmental friendly refrigerant.
- 7.3 List the environmental friendly refrigerant.
- 7.4 State what is meant by ODS, ODP, and GWP.
- 7.5 Explain ozone layered depleting, green house effect and global warming.
- 7.6 Mention the chemical reaction of CFCs with ozone.
- 7.7 Compare commonly used CFC refrigerants with non CFC refrigerants regarding on ODP, GWP and atmospheric life.
- 7.8 Mention the Montreal protocols and the clean air acts on substance that deplete the ozone layer.
- 7.9 Mention the environmental protection agency (EPA) rules governing fully halogenated refrigerants (CFCs).

8 Understand the features of the refrigerant oil.

- 8.1 Outline the importance of refrigerant oil.
- 8.2 Mention the classification of refrigerant oil.
- 8.3 Mention the properties of a good refrigerant oil.

- 8.4 Explain the properties of refrigerant oil.
 - 8.5 Mention the specification of refrigeration oil.
 - 8.6 Explain the causes of more use of naphthene base oils for refrigeration purpose.
 - 8.7 Name the different oils used with the HFC refrigerants.
 - 8.8 Mention the features of synthetic oil used in HFC refrigerant.
 - 8.9 Mention the precaution and safety measure in handling and storing of synthetic oil.
- 9 Understand refrigerant recovery, recycling and reclaim.**
- 9.1 State the meaning of the terms refrigerant recovery, recycling and reclaim.
 - 9.2 Identify the various types of refrigerant recovery and recycling equipment.
 - 9.3 Describe the procedure of liquid refrigerant recovery.
 - 9.4 Describe the procedure of vapor refrigerant recovery.
 - 9.5 Mention the standard safety recommendation to be followed for removing refrigerant from system.
 - 9.6 State what is meant by retrofit.
 - 9.7 Describe the retrofit procedure of R-134a in R-12 system.
 - 9.8 State what is meant by drop-in refrigerant.
 - 9.9 Describe the use of drop-in refrigerant (HC blend in- R-12 unit)
 - 9.10 Compare retrofitting of R-12 system with 134a and HC blend.
- 10 Understand the features of heat pump.**
- 10.1 State what is meant by heat pump.
 - 10.2 Mention the types of heat pump.
 - 10.3 Describe the operation of the different types of heat pump.
 - 10.4 Distinguish between geothermal heat pumps and air source heat pumps.
 - 10.5 Describe the operation of the heat pump reversing valve in heating and cooling mode.
 - 10.6 Describe the simultaneous cooling and heating applications of heat pump (heat pump cascade system).
 - 10.7 Mention the industrial applications of heat pump.
 - 10.8 Analyze the heat pump cycle.
 - 10.9 Mention the design criteria effecting the performance of heat pump.
 - 10.10 Solve problems on heat pumps.
- 11 Understand the features of heat exchanger.**
- 11.1 State the meaning of heat exchanger.
 - 11.2 Outline the importance of heat exchangers.
 - 11.3 Mention the types of heat exchangers.
 - 11.4 Define mean temperature difference.
 - 11.5 Describe the operation of different types of heat exchanger.

- 11.6 Express the deduction of formulae of different types of heat exchangers.
- 11.7 Express the derivation of formulae to calculate overall heat transfer coefficient.
- 11.8 Describe the factors to be considered to design a heat exchanger.
- 11.9 Solve problems relating heat exchangers.

12 Understand the evaporative cooling system.

- 12.1 State what is meant by evaporative cooling systems.
- 12.2 Describe the different ice cooling systems.
- 12.3 Describe the thermodynamics of evaporative cooling.
- 12.4 Mention the types of evaporative cooler.
- 12.5 Describe the operation of different types of evaporative coolers.
- 12.6 Describe the factors to be considered in selection and design of evaporative coolers.
- 12.7 Mention the limitation of simple evaporative cooling system.
- 12.8 Describe the operations of indirect or modified evaporating systems.
- 12.9 Mention the applications of evaporative cooling.

Practical:

1. Study the PH chart.
2. Solve problems of simple vapor compression cycle using PH chart.
3. Solve problems of compound vapor compression cycle using PH chart.
4. Build up a compound compression system.
5. Study the solar heat collection.
6. Study the solar cooling system.
7. Visit a solar energy project.
8. Study the refrigerant recovery unit.
9. Recover refrigerant from a refrigeration system having burnt compressor motor.
10. Recover refrigerant from a refrigerator using piercing valve and a recovery unit.
11. Charge CFC refrigerant in to refrigerator without releasing any refrigerant.

REFERENCE BOOKS

1. Fundamentals of Refrigeration
– Billy C Langley
2. A Text Book of Refrigeration and Airconditioning
– R S Khurmi
J K Gupta
3. A Course in Refrigeration and Airconditioning
– S C Arora
S Domkendar
4. Modern Refrigeration and Airconditioning
– Althouse/Turquist/Bracciano
5. Advance Refrigeration and Airconditioning

– Md. solaiman

3262 TRANSPORT REFRIGERATION AND AIRCONDITONING

T	P	C
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AIM

To provide the students with an opportunity to acquire knowledge, skill and attitude in the area of transport refrigeration and airconditioning with special emphasis on:

- refrigerated trucks and trailers
- trawler refrigeration
- car airconditioning
- bus airconditioning
- rail road car airconditioning
- ship airconditioning
- aeroplane airconditioning
- refrigerated vanding machine.

SHORT DESCRIPTION

Concept of transport refrigeration and airconditioning; Refrigerated trucks and trailers; Trawler refrigeration; Car airconditioning systems; Compressor used in car airconditioning; Car airconditioning; Components of car airconditioning; Control and safety devices of car airconditioning systems ; Servicing and maintenance of auto airconditioning; Bus airconditioning systems; Rail car airconditioning systems; Ship airconditioning systems; Aeroplane airconditioning systems; Refrigerated vanding machines.

DETAIL DESCRIPTION**Theory:****REFRIGERATED TRUCKS AND TRAILERS**

- 1 Understand the concept of transport refrigeration and airconditioning.**
 - 1.1 State what is meant by transport refrigeration and airconditioning.
 - 1.2 Outline the importance of transport refrigeration and airconditioning.
 - 1.3 Identify the various types of transport refrigeration and airconditioning.
 - 1.4 List various non-mechanical transport refrigeration system.
 - 1.5 List various mechanical transport refrigeration and airconditioning system.
 - 1.6 Mention the advantages and disadvantages of non-mechanical transport refrigeration system.
 - 1.7 Mention the advantages and disadvantages of mechanical transport refrigeration and airconditioning.

- 1.8 Mention the significance of mechanical transport refrigeration.
- 2 Understand features of refrigerated trucks and trailers.**
- 2.1 Identify the various truck refrigeration system.
- 2.2 Describe the body insulation process of refrigerated trucks and trailers.
- 2.3 Describe the product sub-cooling in truck refrigeration system.
- 2.4 Describe the operation of expendable refrigerant truck refrigeration system.
- 2.5 Describe the operation of eutectic solution in truck refrigeration system.
- 2.6 Describe the operation of self contained truck refrigeration system.
- 2.7 Describe the servicing procedure of a conventional truck refrigeration system.

TRAWLER REFRIGERATION

- 3 Understand the concept of trawler refrigeration.**
- 3.1 Mention the factors to be considered in trawler refrigeration system.
- 3.2 Describe the refrigeration system of fishing trawler used for fishing near the shore.
- 3.3 Describe the refrigeration system of fishing trawler used for fishing at deep shore.
- 3.4 Mention the problems encountered in truck refrigeration system with their remedies.

CAR AIRCONDITIONING

- 4 Understand the concept of car airconditioning systems.**
- 4.1 State the purpose of automobile airconditioning.
- 4.2 Describe the refrigeration cycle of a car airconditioning system.
- 4.3 Distinguish between cycling and non-cycling compressors used in car airconditioning system.
- 4.4 Mention the importance of receiver used in car airconditioning system.
- 4.5 State the purpose of accumulator used in car airconditioning system.
- 4.6 Describe heating system of auto airconditioning.
- 4.7 Describe air distribution system in car airconditioning.
- 5 Understand the features of compressors used in car airconditioning.**
- 5.1 Mention the types of compressors used in car airconditioning system.
- 5.2 Describe the operation of different types of commonly used compressors.
- 5.3 Mention the advantages of swash plate compressors over rotary reciprocating compressor used in car airconditioning.
- 5.4 Mention the advantages of variable displacement swash plate compressor over fixed displacement swash plate compressor.
- 5.5 Mention the significance of scotch yoke compressor.
- 5.6 Mention the advantages and disadvantages of variable displacement scroll compressors.

- 5.7 Mention the importance of compressor shaft seal used in auto motive airconditioning system.
- 5.8 Describe the procedure of compressor drive belt tension adjustment.
- 6 Understand the features of component of car airconditioning.**
 - 6.1 Mention the significance of condenser used in car airconditioning.
 - 6.2 Describe the construction of receiver drier used in car airconditioning.
 - 6.3 List the expansion devices used in automotive airconditioning system.
 - 6.4 Describe the operation of different types expansion devices used in automobile airconditioning system.
 - 6.5 Identify the different types of evaporators used in car airconditioning system.
 - 6.6 Identify the different types of clutches used in car airconditioning.
 - 6.7 Mention the advantages of heli-grip clutch over conventional type magnetic clutch.
- 7 Understand the concept of controls and safety devices of car airconditioning.**
 - 7.1 Identify the control devices used in airconditioning.
 - 7.2 Describe the control of evaporator temperature by electric pressure switch.
 - 7.3 Describe the control of evaporator temperature by the thermostatic cycling switch.
 - 7.4 Describe the control of the evaporator temperature by suction pressure control valves.
 - 7.5 Describe the electronic control system of car airconditioning.
 - 7.6 Identify electromagnetic, thermo pneumatic and electro servo system used for temperature and climate control of car airconditioning.
 - 7.7 Identify the safety devices used in car airconditioning system.
 - 7.8 Describe wiring system of the compressor clutch including all safety and control devices.
 - 7.9 Identify the components used in car airconditioner panel board.
- 8 Understand the servicing and maintenance of auto airconditioning system.**
 - 8.1 What is meant by auto airconditioner servicing and maintenance.
 - 8.2 Describe sight glass indications for various conditions in the refrigeration system of auto airconditioner.
 - 8.3 Mention the contaminants and their effects on auto airconditioning system.
 - 8.4 Describe the procedure of performance test of a car airconditioner.
 - 8.5 Describe the process of leak detection of auto airconditioner.
 - 8.6 Describe the process of evacuating refrigeration cycle used in auto air conditioner.

8.7 Describe the charging process of refrigerant in a refrigeration cycle used in auto airconditioner.

8.8 Describe the process of inspection of compressor on the vehicle.

BUS AIRCONDITIONING

9 Understand the concept of bus airconditioning system.

9.1 Describe the dual compressor refrigeration cycle of a bus airconditioning system.

9.2 Describe the different components of bus airconditioner refrigeration cycle.

9.3 Mention possible locations on bus air conditioner.

9.4 Describe air distribution systems of bus air conditioner.

9.5 Describe the control system of bus airconditioning system.

9.6 Describe the process of inspection and maintenance of bus air conditioner.

9.7 Describe the procedure of servicing of a bus airconditioner.

9.8 Identify the electric circuit of bus airconditioning system.

9.9 Mention typical specification of bus airconditioner.

RAIL CAR AIRCONDITIONING

10 Understand the concept of rail car airconditioning system.

10.1 Describe the cooling systems used in rail car air conditioner.

10.2 Describe the power systems of rail car air conditioner.

10.3 Describe the air distribution system of a rail car air conditioner.

SHIP AIRCONDITIONING

11 Understand the features of ship airconditioning.

11.1 Mention the factors to be considered in designing ship airconditioning system.

11.2 Identify the components of refrigeration cycle of ship airconditioning systems.

11.3 Describe the airconditioning methods of ship airconditioning systems.

11.4 Describe the air distribution methods of ship airconditioning systems.

11.5 Describe ventilation requirement in ship airconditioning systems.

11.6 Mention the refrigerants used in refrigeration cycle of ship airconditioning plant.

AEROPLANE AIRCONDITIONING

12 Understand the concept of aeroplane airconditioning system.

12.1 Mention the importance of aeroplane airconditioning.

12.2 Mention the heat sources of aeroplane airconditioning.

12.3 List the air cycles used in aeroplane airconditioning.

12.4 Describe different air cycles used in aeroplane airconditioning systems.

12.5 Mention the advantages and disadvantages of air cooling system used in aeroplane.

- 12.6 Mention the advantages and disadvantages of vapor compression refrigeration system used in air craft.

VANDING MACHINES

13 Understand the concept of refrigerated vanding machines.

- 13.1 State the meaning of the vanding machine.
 13.2 Outline the importance of refrigerated vanding machine.
 13.3 List different types of refrigerated vanding machine.
 13.4 Mention the functions of vanding machines.
 13.5 Describe the dispensing methods of vanding machines.
 13.6 Identify the controls of vanding machines.

Practical :

1 Study of refrigeration cycle used in car airconditioning.

- 1.1 Identify the components of refrigeration cycle used in car airconditioning.
 1.2 Start the refrigeration cycle.
 1.3 Inspect the operation refrigeration cycle.

2 Study the air distribution system of car airconditioner.

- 2.1 Identify the components of air distribution systems used in car airconditioning.
 2.2 Start the blower at different speed condition.
 2.3 Operate the air conditioner at idle speed.
 2.4 Start air conditioner at motion of car.

3 Study the car airconditioner compressor.

- 3.1 Identify the different components of a reciprocating compressor.
 3.2 Identify the different components of a fixed displacement swash plate compressor.
 3.3 Identify the different components of a variable displacement swash plate compressor.
 3.4 Identify the different components of a scotch yoke type compressor.
 3.5 Identify the different components of a scroll type compressor.

4 Study the compressor clutch used in automobile airconditioner.

- 4.1 Identify the different types of magnetic clutches.
 4.2 Test the clutch field coil.
 4.3 Remove the clutch assembly.
 4.4 Disassemble the clutch pulley assembly.
 4.5 Assemble the clutch pulley assembly.
 4.6 Install the clutch pulley assembly.
 4.7 Start the compressor with the magnetic clutch.

5 Study the service procedure of compressor used in car air conditioner

- 5.1 Isolate the compressor from the system.
 5.2 Dismount the compressor.
 5.3 Disassemble the compressor.

- 5.4 Replace compressor shaft seal.
- 5.5 Assemble the compressor.
- 5.6 Remount the compressor.
- 5.7 Connect the compressor with the refrigeration system.
- 5.8 Start the compressor.
- 5.9 Add oil to the compressor.
- 5.10 Adjust the drive belt tension.
- 6 Study the electrical circuit of a car air conditioner.**
 - 6.1 Identify the components of electrical circuits of a car air conditioner.
 - 6.2 Check the correct operation of the electrical components of electrical circuits of a car air conditioner.
- 7 Study the service procedure of car air conditioners system.**
 - 7.1 Connect gage manifold into the refrigeration system of a car air conditioner.
 - 7.2 Evacuate the refrigeration system.
 - 7.3 Check for leak in the refrigeration system.
 - 7.4 Charge refrigerant into the system.
 - 7.5 Start the refrigeration system for correct charge.
- 8 Study the refrigeration system of a refrigerated van / Truck.**
 - 8.1 Identify the components of a conventional refrigeration cycle.
 - 8.2 Identify the components of eutectic plate refrigeration system.
 - 8.3 Cool the eutectic plate with power take off system in the charging station.
 - 8.4 Charge the refrigerant into the refrigerant system of the truck.
- 9 Study the bus airconditioning system.**
 - 9.1 Identify the components of refrigeration cycle used in bus airconditioning system.
 - 9.2 Identify the components of air distribution system used in bus airconditioning.
 - 9.3 Start the airconditioning system of bus.
- 10 Study the service procedure of bus airconditioning system.**
 - 10.1 Connect gage manifold to the refrigeration system of bus airconditioner.
 - 10.2 Measure the suction and discharge pressure for correct charge condition.
 - 10.3 Diagnose the problems from side glass indications.
 - 10.4 Detect leak in the refrigeration system.
 - 10.5 Charge the refrigerant into the refrigeration system.
- 11 Study the performance test of a car air conditioner.**
 - 11.1 Connect gage manifold to the refrigeration system.
 - 11.2 Start the car airconditioning system.
 - 11.3 Measure the suction and discharge pressure.

- 11.4 Measure the ambient and the discharge air temperature of the evaporator.
- 11.5 Compare the calculated performance with the manual.

REFERENCE BOOKS

- 1. Automotive Mechanics
 - Crouse Anglin
- 2. Modern Refrigeration and Airconditioning
 - Althouse/Turnquist/Braceiano

3267 RAC PLANT OPERATION

T	P	C	
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AIMS

To provide the students with an opportunity to acquire knowledge, skill and attitude in the area of refrigeration & air conditioning plants operation and maintenance with a special emphasis on:

- operation of refrigeration and air conditioning plant.
- plant commissioning.
- maintenance.

SHORT DESCRIPTION

Operation of refrigeration plant; Test operation on commissioning; Starting operation of a refrigeration plant which is started in every morning and shutdown in every evening; Starting method of a refrigeration plant which is shutdown for a long time; Gas charging in Refrigeration plant; Stopping operation of a refrigeration plant; Maintenance of a refrigeration and Air conditioning plant; Maintenance of the refrigeration & Air conditioning equipment; Safe & smooth operation of a plant.

DETAIL DESCRIPTION**Theory:**

- 1 Understand the operation of refrigeration plants.**
 - 1.1 State the meaning of refrigeration plant operation.
 - 1.2 State the necessity of recording the reading of temperature for a refrigeration plant.
 - 1.3 Explain with necessary sketch to show the thermometer position on refrigeration cycle.
 - 1.4 Explain the cause of thermometer in the suction line close to the compressor.
 - 1.5 State the purpose of a thermometer in the discharge line.
 - 1.6 Explain the importance of discharge and suction pressure gauge in a refrigeration plant.
 - 1.7 Explain the ideal temperature difference between refrigerant and the substance.
- 2 Understand the test operation on commissioning.**
 - 2.1 Explain the term commissioning.
 - 2.2 Describe the importance check point which should be thorough checked after completion of erection of the plant.
 - 2.3 List the test operation which should be carried out on commissioning.
 - 2.4 Describe the test operations which should be carried out on commissioning.

- 2.5 List the readings of plant when the system has been stabilized for future servicing and trouble shooting.
- 2.6 List the data that should be collected before proceeding to check the performance of the plant.
- 3 Understand the starting operation of a refrigeration plant which is started in every morning and shut down in every evening.**
 - 3.1 List the works which should be ensured before starting the plant.
 - 3.2 Describe starting sequence and importance significance of each step.
 - 3.3 Explain the necessity of recording the temperature, Pressure, flow rate, voltage and ampere of the plant when running.
- 4 Understand the starting operation of a refrigeration plant which is shutdown for a long period.**
 - 4.1 List all the safety precautions those are to be taken before starting a refrigeration plant.
 - 4.2 Describe the starting sequence of the refrigeration plant.
 - 4.3 State the necessity of recording all the available readings of the plants when starting and running.
 - 4.4 State how to make decision for plant operations on the basis of the readings available.
- 5 Understand the gas charging in a refrigeration plant.**
 - 5.1 Describe the desirable conditions in favour of gas charging.
 - 5.2 Describe the process of charging R-407, R-507, R-134a into a refrigeration plant.
 - 5.3 Describe the charging process of ammonia gas in a large refrigeration system.
 - 5.4 Describe the full gas charge indication in a large refrigeration system.
 - 5.5 Explain the process of an removing/withdraw refrigerant from a system.
 - 5.6 Explain the precautions to be taken when withdrawing ammonia from a plant.
- 6 Understand the stopping operation of a refrigerant plant.**
 - 6.1 State the process of stopping a refrigeration plant.
 - 6.2 Describe the important points to be taken care of stopping a running refrigeration plant.
 - 6.3 Describe the important points to be taken care of stopping a running air conditioning plant.
 - 6.4 Describe the stopping sequence of a large refrigeration plant.
 - 6.5 Describe the stopping sequence of a central air conditioning plant.
 - 6.6 state what is meant pump down system.
 - 6.7 Describe pump down system.
- 7 Understand the maintenance of a refrigeration and air conditioning plant.**
 - 7.1 Describe the purpose of the maintenance of a refrigeration plant.

- 7.2 Describe the meaning of maintenance, preventive maintenance, post operative maintenance, scheduled maintenance, periodic maintenance and routine maintenance.
- 7.3 State the preventive maintenance work for a refrigeration plant.
- 7.4 State the post operative maintenance work for a refrigeration plant.
- 7.5 Prepare a schedule of periodic maintenance for large refrigeration plant.
- 7.6 Prepare a schedule of periodic maintenance for a central air conditioning plant.

8 Understand the maintenance of the equipment of a refrigeration and air conditioning plant.

- 8.1 Describe the maintenance of compressor.
- 8.2 Describe the maintenance of condenser.
- 8.3 Describe the maintenance of cooling tower.
- 8.4 Describe the maintenance of shell & tube type chiller.
- 8.5 Describe the maintenance of auxiliaries of refrigeration and air conditioning plants.
- 8.6 Describe the maintenance of AHU and FCU of air conditioning plant.
- 8.7 Describe maintenance of a pump.

9 Understand the safe and smooth operation of a refrigeration plant.

- 9.1 State the purpose of safety of refrigeration plant.
- 9.2 List the safety devices of a large refrigeration and air condition plant.
- 9.3 State the function of each safety devices of a refrigeration plant.
- 9.4 Describe the adjustment & setting required for the operating control and safety devices.
- 9.5 Describe the reasons of failure of smooth operation of a large refrigeration & air conditioning plant.
- 9.6 Describe the correcting steps to be taken for smooth operation.

Practical:

1. Operate a commercial plant, record the reading of temperature and pressures of different points. Use these datas for the calculation of capacity and COP.
2. Adjust LP and HP cutout for a given evaporating and condensing temperature and pressure.
3. Prepare a log sheet for a commercial plant.
4. Visit a commercial refrigeration plant and watch how to start & stop the plant and write a report on your visit.
5. Visit a central air conditioning plant and record all the variable during starting and running a refrigeration plant and write a report on your visit.
6. Charge a commercial plant.
7. Purge a commercial refrigeration plant.
8. Charge oil in a big compressor.
9. Do the necessary maintenance work of a cooling tower.
10. Clean a shell & tube water cooled condenser.

REFERENCE BOOKS

- 1 A Text Book of Refrigeration & Air conditioning
- RS Khurmi & JK Gupta.
- 2 Refrigeration & Air conditioning
- PL Ballaney.
- 3 A Course in Refrigeration and Air conditioning
- SC Arora
- S Domkundwar

3268 RAC CIRCUITS & CONTROLS- II

T	P	C		
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AIMS

To provide the students with an opportunity to acquire knowledge, skill and attitude in the area of refrigeration and air-conditioning circuits and controls with the special emphasis on:

- control system terminology
- controllers
- mechanical refrigeration controls
- motor controls
- pneumatic control system
- cooling unit controls
- control of distribution
- controls and safety controls of refrigeration and air-conditioning plants
- Electronic control.
- Digital control
- Electronic Thermostat

SHORT DESCRIPTION

Terminology of the control system; Controllers used in refrigeration and air-conditioning; Terminology of pneumatic controls systems; Mechanical refrigeration control; Motor control hook ups; Concept of pneumatic control; Pneumatic control combination; Commercial central fan cooling system; Control of distribution; Controls and safety controls used in refrigeration plants; Controls and safety controls, electronic control, digital control, thermostat used in air-conditioning plants.

DETAIL DESCRIPTION**Theory:****CONTROL SYSTEM TERMINOLOGY****1 Understand the terminology of the control system.**

- 1.1 State the meaning of control agent, controlled medium, operating controls, primary controls, limit controls, set point, Control point, deviation, differential gap, offset / droop / driff, controlling element, two position control, proportional control, compensated control, floating control, lag, reset controls, modulating control, Limit controls, control

hunt, controlled variable, cycling, instability, night setback, three wire control, two wire control, zone control, thermostat, clock thermostat.

- 1.2 State the function of thermostat, clock thermostat, day-night thermostat, differential thermostat, dual thermostat, remote bulb thermostat, surface thermostat control, summer-winter thermostat.

2 Understand the controls, controller and controls system, controllers used in refrigeration and air-conditioning.

- 2.1 State the meaning of control, controller and control system.
 2.2 Mention the elements of control controller and control system.
 2.3 Describe different types of control such as temperature, pressure, liquid or gas flow, liquid level, timed operations.
 2.4 Describe different types of controller such as primary control, operating control, limit controls.
 2.5 Describe different types of control system such as electric, pneumatic, electronic, fluidic and combination of the above.
 2.6 Describe the purpose of master controller and submaster controller.
 2.7 State the function of immersion controller.
 2.8 State the function of reverse acting controller.
 2.9 Describe the purpose of a sequence controller.
 2.10 State the function of snap acting controller.

MECHANICAL REFRIGERATION CONTROLS

3 Understand the mechanical refrigeration controls.

- 3.1 State the requirement of mechanical refrigeration control.
 3.2 Describe the operation of different types of refrigerant flow controls.
 3.3 State the meaning of capacity control of a compressor.
 3.4 Describe the operation of suction pressure control of single compressor.
 3.5 Describe the operation of a discharge pressure of a compressor.
 3.6 Describe the operation of stage control of multiple compressor.
 3.7 Describe the operation of sequence switch control of multiple compressor.
 3.8 Describe the different types of capacity control of various compressors.
 3.9 Describe the method of controlling the air for condenser cooling.

MOTOR CONTROLS**4 Understand the motor controls hook ups.**

- 4.1 State the meaning of motor control hookup.
- 4.2 State the function of magnetic starter.
- 4.3 Describe the components of magnetic starter with symbolic diagram.
- 4.4 Describe the operation of a magnetic starter with symbolic diagram.
- 4.5 Describe the operation of two wire control circuit of magnetic starter.
- 4.6 Describe the operation of three wire control circuit of magnetic starter.
- 4.7 Describe the operation of a magnetic starter having three wire control circuit and NO start button with NC stop button.
- 4.8 Describe the operation of a magnetic starter with auxiliary contacts to control other starters.
- 4.9 Describe the operation of a magnetic starter with HAND and AUTO switch control circuit.
- 4.10 Describe the operation of a control circuit of a three phase motor for forward and reverse rotation.
- 4.11 Describe the operation of a three phase motor with magnetic starter and timer for star delta starting system

5 Understand the terminology of pneumatic control system.

- 5.1 State the meaning of actuator, transducer, control motors, control valves, damper motor, direct acting valve, diverting valve, double seated valves, relay, electric pneumatic relays, graduate relays, mixing valve, motor valve, normally closed valve, normally open valve, pneumatic-electric relay, positive positioning relay, primary control, program relay, radiator valve, single seated valve, solenoid valve, three way valve, unidirectional motor.
- 5.2 State the function of pneumatic electric relay.
- 5.3 State the purpose of positive positioning relay.

PNEUMATIC CONTROL**6 Understand the fundamental concept of pneumatic control.**

- 6.1 State the meaning of pneumatic control system.
- 6.2 Mention the advantages of pneumatic controls.
- 6.3 Mention the elements of pneumatic controls.
- 6.4 State the meaning of pneumatic actuator, pneumatic controllers, throttling ranges, sensitivity of controller.
- 6.5 Describe different types of pneumatic controllers.
- 6.6 Mention the functions of pneumatic actuators.
- 6.7 Describe the operation of the basic power unit.
- 6.8 Describe the operation of the positive positioning relay.
- 6.9 Describe the operation of a pneumatic control valve.

7 Understand the concept of pneumatic control combination.

- 7.1 State the meaning of pneumatic control of control combinations.
- 7.2 Describe the operation of elementary pneumatic control circuit.
- 7.3 Describe the operation of pneumatic thermostat and low limit control.
- 7.4 Describe the operation of pneumatic thermostat and high limit control circuit.
- 7.5 Describe the operation of bleed type low limit control.
- 7.6 Describe the operation of three position manual switch connected with a pneumatic control system.
- 7.7 Describe the operation of electric pneumatic relay.
- 7.8 Describe the operation of system shut down with pneumatic relay.
- 7.9 Describe the operation of compensated control.
- 7.10 State the function of day-night thermostat and summer winter thermostat.

CONTROLS OF COOLING UNIT

- 8 Understand the control of commercial central fan cooling system.**
 - 8.1 Describe the operation of thermostat control of cold water coil of airconditioning system.
 - 8.2 Describe the operation of temperature and humidity control of coil.
 - 8.3 Describe the operation of valve and by pass control of coil.
 - 8.4 Describe the operation of valve control of direct expansion coil.
 - 8.5 Describe the operation of valve and damper control direct expansion system.
 - 8.6 Describe the operation of valve and damper method with humidity control added.
 - 8.7 Describe the proportional control of multistage compressors.
 - 8.8 Describe the operation of temperature humidity control of reheat system.
 - 8.9 Describe the operation of out door air control with exhaust damper.
- 9 Understand the control of distribution.**
 - 9.1 Describe the various methods of distribution control (liquid refrigerant, coolant flow, air flow, chilled water flow).
 - 9.2 Describe the methods of liquid refrigerant flow control.
 - 9.3 Describe the proportional control of coolant flow.
 - 9.4 Describe the proportional control of air flow in airconditioning system.
 - 9.5 Describe the method of controlling chilled water distribution system.
- 10 Understand the controls and safety controls used in refrigeration plants.**
 - 10.1 Name the controls and safety controls used in refrigeration plants.
 - 10.2 State the function of different types of control and safety controls used in refrigeration plants.
 - 10.3 Describe the operation of control circuit of an industrial refrigeration plants.
- 11 Understand the controls and safety controls used in airconditioning plants.**

- 11.1 Name the controls and safety controls used in airconditioning plants.
- 11.2 Describe the function of each control and safety controls device used in airconditioning plants.
- 11.3 Describe the operation of control circuit of an airconditioning plant.

12 Understand the controls and safety controls used in airconditioning plants.

- 12.1 State the meaning of electronic thermostat
- 12.2 Mention the application of electronic thermostat.
- 12.3 Draw an electrical diagram for an electronic thermostat.
- 12.4 Mention the different functions of electronic thermostat.
- 12.5 Mention the additional feature of electronic thermostat.
- 12.6 Mention the advantage of electronic thermostat.
- 12.7 Mention troubles, possible cause and corrective action an electronic thermostat.

13 Understand the concept of Digital control.

- 13.1 State the meaning of direct digital control.
- 13.2 Mention the types of direct digital control
(Localized controllers, Remote controllers and centralized computer controller.)
- 13.3 Describe the localized control system.
- 13.4 Describe the remote control system.
- 13.5 Describe the centralized computer control system.
- 13.6 Mention Digital control system diagnostics and Repair.

Practical:

1. Test a differential thermostat.
2. Test the bimetal type thermostat.
3. Test the summer winter thermostat.
4. Test a back pressure regulating valve.
5. Build up a circuit temperature & pressure control of a commercial refrigeration system.
6. Test a voltage stabilizer and a voltage protector with voltage regulator.
7. Test a two wire control circuit of a magnetic starter to start & stop a motor.
8. Test a three wire control circuit of a magnetic starter to start & stop the motor.
9. Build up a electrical control circuit to rotate a three phase motor in reverse and forward.
10. Build up an electrical inter locking circuit with magnetic starters.
11. Build up an electrical circuit of star delta method of starting circuit.
12. Build up a control and safety control circuit for a refrigeration plant.
13. Build up a control circuit for a airconditioning plant.
14. Build up an electrical circuit to control the capacity of a compressor motor.
15. Build up an electrical circuit to control the condenser cooling air flow.
16. Test an electrical circuit of commercial system for defrosting.

17. Visit a cold storage and submit a report to the followings:
 - a. Power supply distribution system.
 - b. PFI plant.
 - c. LT switchgear
 - d. HT switchgear
 - e. Control devices.
 - f. Safety devices.
 - g. Starting and stopping methods.

18. Visit an airconditioning plant and submit a report to the following:
 - a. Power supply distribution system.
 - b. Control devices.
 - c. Safety devices.
 - d. Starting and stopping methods.

REFERENCE BOOKS

1. Refrigeration and Airconditioning Circuits and Controls-II
– Md. Solaiman
2. Automatic Control of Heating and Airconditioning
– Haines

3269 FLUID MECHANICS AND MACHINERIES

T	P	C
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AIMS

To provide the students with an opportunity to acquire knowledge, skill and attitude in the area of fluid mechanics and machinery with special emphasis on :

- properties of fluids
- fluid pressure measurement
- Bernoulli's equation
- orifice and mouthpieces
- impact of jet
- water pumps & turbines
- hydraulic devices
- compressors

SHORT DESCRIPTION

Scope of fluid mechanics; Properties of fluid; Fluid pressure measurement; Flow of fluids through pipes; Bernoulli's equation; Flow through orifices; Flow through mouthpieces; Viscous flow; Impact of jets; Water turbine; Reciprocating pumps; Centrifugal pumps; Rotary pumps; Deep well & tubine pumps; Hydraulic devices; Reciprocating air compressor; Rotary air compressor.

DETAIL DESCRIPTION**Theory :****SCOPE OF FLUID MECHANICS**

- 1 **Understand the scope of hydraulics.**
 - 1.1 Define fluid mechanics and fluid machinery.
 - 1.2 Outline the importance of fluid mechanics and machinery
 - 1.3 Mention the branches of fluid mechanics.
 - 1.4 Identify different application of fluid mechanics and fluid machinery engineering field.

PROPERTIES OF FLUIDS

- 2 **Understand the properties of fluids.**
 - 2.1 Define fluid.
 - 2.2 Mention the classification of fluids.
 - 2.3 Compare the liquid, vapor and gas.
 - 2.4 Describe various properties of fluids.

2.5 Solve problems on properties of fluids.

FLUID PRESSURE MEASUREMENT

3 Understand the concept of fluid pressure.

- 3.1 Define pressure and intensity of pressure.
- 3.2 State the formula for finding pressure and pressure head of fluids.
- 3.3 Mention the significance of fluid pressure.
- 3.4 State Pascal's law of fluid pressure.
- 3.5 Define atmospheric pressure, gage pressure and absolute pressure.
- 3.6 Mention the relation among atmospheric pressure, gage pressure and absolute pressure.
- 3.7 Express the derivation of the formulae for finding total pressure on immersed surface at horizontal, inclined and vertical position.
- 3.8 Calculate the total pressure on the bottom and walls of a tank filled with liquid.
- 3.9 Solve problems on the static fluid pressure.

4 Understand the features of fluid pressure gages.

- 4.1 State the meaning of pressure gage.
- 4.2 Mention the classification of pressure gages.
- 4.3 Define manometer.
- 4.4 Distinguish between simple manometer and differential manometer.
- 4.5 Mention the working principle of different types of pressure gages.
- 4.6 Mention the specific application of different pressure gages.
- 4.7 Solve problems relating to the measurement of fluid pressure by different manometer.

FLOW OF FLUID THROUGH PIPES

5 Understand the concept of flow of fluid through pipes.

- 5.1 Identify different types of flow of fluid in pipe.
- 5.2 Mention different types of flow lines.
- 5.3 State what is meant by flow rate or discharge.
- 5.4 Compute the formula of flow through pipes.
- 5.5 State the equation of continuity of flow.
- 5.6 Solve problems on flow of fluid through pipes.

BERNOULLI'S EQUATION

6 Understand the concept of Bernoulli's equation.

- 6.1 Define head, pressure head, velocity head, datum head and total head.
- 6.2 Identify the form of energy existence of liquid in motion.
- 6.3 Mention the total energy of a liquid in motion.
- 6.4 State the Bernoulli's equation for flowing liquid.
- 6.5 Express the proof of Bernoulli's equation.
- 6.6 Mention the limitation of Bernoulli's equation.
- 6.7 Solve problems on Bernoulli's equation.

7 Understand the application of Bernoulli's equation.

- 7.1 Mention the functions of venturimeter, orificemete, rotameter, current meter and pitot tube.
- 7.2 Describe the construction of venturimeter, orificemeter and pitot tube.
- 7.3 Describe the operations of venturimeter, orificemeter and pitot tube.
- 7.4 Express the derivation of formula to measure the quantity of liquid flowing through venturimeter.
- 7.5 Express the derivation of formula to measure the quantity of liquid flowing through orificemeter.
- 7.6 Describe the operations of rotameter to measure the flowrate of liquid.
- 7.7 Express the derivation of formula to measure the velocity of flowing liquid through the pitot tube and current meter.
- 7.8 Solve the problems on venturimeter, orificemete, pitot tube and current meter.

FLOW THROUGH ORIFICES

8 Understand the concept of flow through orifices.

- 8.1 Define orifice.
- 8.2 Mention the classification of orifices.
- 8.3 State what is meant by hydraulic coefficient.
- 8.4 Define jet of water, vena contracta, coefficient of contraction (C_c), coefficient of velocity (C_v), coefficient of discharge (C_d) and coefficient of resistance.
- 8.5 Relate the C_c , C_v and C_d .
- 8.6 Calculate the coefficient of velocity from laboratory data.
- 8.7 Express the deduction of formulae for finding the discharge of liquid through various orifices
- 8.8 Express the deduction of formulae to calculate the time of emptying rectangular and hemispherical tanks.
- 8.9 Solve problems relating orifices.

FLOW THROUGH MOUTHPIECES

9 Understand the concept of flow through mouthpieces.

- 9.1 State what is meant by mouthpiece.
- 9.2 Mention the classification of mouthpieces.
- 9.3 Express the deduction of formulae to calculate discharge through different types of mouthpieces.
- 9.4 State what is meant by head loss of flowing liquid.
- 9.5 List the causes of head loss of flowing liquid.
- 9.6 Express the deduction of formulae to calculate loss of head due to sudden enlargement, sudden contraction and obstruction in pipe.
- 9.7 State what is meant by friction loss of flowing liquid.
- 9.8 Express the deduction of formulae to calculate loss of head due to friction (Darcy's and Cheay's formulae).

- 9.9 Solve problems relating head losses and discharge through mouthpieces.

VISCOUS FLOW

10 Understand the concept of viscous flow.

- 10.1 Define viscosity.
 10.2 Mention the units of viscosity.
 10.3 Define ideal fluid, real fluid, Newtonian fluid and non-Newtonian fluids.
 10.4 State what is meant by Reynold's number.
 10.5 Describe reynold's experiment of viscus slow.
 10.6 Solve problems relating viscous flow.

IMPACT OF JETS

11 Understand the aspect of impact of jets.

- 11.1 State what is meant by impact of jet.
 11.2 Express the deduction of formula to calculate the force of a jet impinging on a fixed vertical flat plate and an inclined flat plate.
 11.3 Express the deduction of formula to calculate the force of a jet impinging on a fixed curve vane.
 11.4 Express the deduction of formula to calculate the force of a jet impinging on the moving curve vane.
 11.5 Solve problems on impact of jets.

WATER TURBINES

12 Understand the features of water turbines.

- 12.1 State the meaning of water turbine.
 12.2 Mention the classification of water turbine.
 12.3 Describe the principle of impulse and reaction water turbine.
 12.4 Compare the impulse and reaction turbines.
 12.5 Describe the components of impulse and reaction turbines.
 12.6 Describe the construction of Pelton, Kaplan and Francis water turbine.
 12.7 Describe the operation of Pelton, Kaplan and Francis water turbine.
 12.8 State what is meant by specific speed of turbine.
 12.9 Describe the governing system of impulse and reaction turbines.

RECIPROCATING PUMPS

13 Understand the features of reciprocating pumps.

- 13.1 State the meaning of reciprocating pump.
 13.2 Mention the classification of reciprocating pumps.
 13.3 Describe the construction of various reciprocating pumps.
 13.4 Describe the operation of different types of reciprocating pumps.
 13.5 State the meaning of slip of reciprocating pumps.
 13.6 Mention the function of air vessel in single acting reciprocating pump.
 13.7 Describe the operation of suction side and discharge side air vessel in a single acting reciprocating pump.

13.8 Express the deduction of formula to calculate the discharge of reciprocating pumps.

13.9 Solve problems relating reciprocating pumps.

CENTRIFUGAL PUMPS

14 Understand the features of centrifugal pumps.

14.1 State the meaning of centrifugal pump.

14.2 Mention the classification of centrifugal pumps.

14.3 Compare the centrifugal and reciprocating pumps.

14.4 Describe the construction of various centrifugal pumps.

14.5 Describe the operation of different types of centrifugal pumps.

14.6 Express the deduction of formula to calculate discharge of centrifugal pumps.

14.7 Express the deduction of formula to calculate manometric head of centrifugal pumps.

14.8 Mention the efficiencies of centrifugal pump.

14.9 Solve problems relating centrifugal pumps.

HYDRAULIC DEVICES

15 Understand the features of hydraulic devices.

15.1 State what is meant by hydraulic devices.

15.2 Mention the function of hydraulic devices viz. hydraulic press, hydraulic accumulator, hydraulic intensifier, hydraulic crane, hydraulic lift, etc.

15.3 Describe the constructions of various hydraulic devices.

15.4 List the advantages and disadvantages of rotary pumps over the reciprocating and centrifugal pump.

15.5 Mention the application of rotary pumps.

DEEP WELL PUMP AND TURBINE PUMP

16 Understand features of deep well pump and turbine pump.

16.1 State what is meant by turbine pump.

16.2 Mention the function of deep well pump.

16.3 Mention the classification of deep well pump.

16.4 Describe the working principles of the deep well pump and the turbine pump.

16.5 Describe the construction of submersible type deep well pump.

16.6 Describe the operation of a submersible type deep well pump.

16.7 Describe the working principle of jet pump.

16.8 Describe the working principle of air lift pump.

COMPRESSORS

17 Understand the features of reciprocating air compressor.

17.1 State what is meant by air compressor.

17.2 Mention the classification of air compressor.

17.3 Describe working principle of single stage reciprocating air compressor.

- 17.4 Mention the advantages of multistage of air compressor.
- 17.5 Mention the function of inter cooler and after cooler of a multistage air compressor.

18 Understand the features of rotary air compressor.

- 18.1 State what is meant by rotary air compressor.
- 18.2 Distinguish between reciprocating and rotary air compressors.
- 18.3 Mention types of rotary air compressors.
- 18.4 Describe the operation of different types of rotary air compressor.
- 18.5 Distinguish between centrifugal and axial flow air compressor.
- 18.6 State what is meant by efficiency of air compressor.
- 18.7 Solve problem related to efficiency of air compressor.

Practical :

1. Calibrate a bourdon tube pressure gage with a dead weight gage.
2. Verify Bernoulli's equation by Bernoulli's apparatus equipped with hydraulic test bench.
3. Determine C_c , C_v , and C_d by orifice apparatus equipped with hydraulic test bench.
4. Determine the discharge of water through a pipe by the venturimeter or orifice meter equipped with hydraulic test bench.
5. Determine the loss of head due to sudden enlargement of pipe by the manometer.
6. Determine the loss of head due to friction by fluid friction apparatus.
7. Determine the loss of fluid energy loss through various fittings (elbows, bends and valves).
8. Test the performance of a reciprocating pump with the reciprocating pump test rig.
9. Test the performance of a centrifugal pump with the centrifugal pump test rig.
10. Test the performance of an impulse turbine with the impulse (Pelton wheel) turbine test rig.
11. Test the performance of a Francis turbine with the Francis turbine test rig.
12. Determine the leverage and mechanical advantage of a hydraulic press.
13. Identify the components of hydraulic crane.
14. Identify the different components of a two stage reciprocating air compressor.

REFERENCE BOOKS

- 1 A Text Book of Hydraulics, Fluid Mechanics and Hydraulic Machines
– R. S. Khurmi
- 2 Fluid Mechanics Hydraulics and Hydraulic Machines
– K. R. Arora

- 3 Hydraulics, Fluid Mechanics, and Fluid Machines
 – S. Ramamrutham
- 4 Fluid Mechanics including Hydraulics Machines
 – K. Subramanya

1355 ENVIRONMENTAL MANAGEMENT	T	P	C	
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AIMS

- To be able to understand the basic concepts of environment and environmental pollution.
- To be able to understand the concepts of ecology, ecosystems, air pollution, water pollution, soil pollution, radioactive pollution, sound pollution, etc.
- To be able to understand the methods of controlling air pollution, water pollution and sound pollution.
- To be able to understand the management of waste, pesticide pollution and soil pollution.
- To be able to understand the global environmental issues and the environmental problems in Bangladesh.

SHORT DESCRIPTION

Basic concepts of environment; Ecology & eco-systems; Air and atmospheric regions; Toxic chemicals, gases, vapours, fumes, pesticides & microbials; Air pollution and its sources & effects; Green house effect and depletion of ozone layer; Control of air pollution; Water pollution and its sources & effects; Monitoring of water pollution; Waste water treatment; Sound pollution and its control; Soil pollution and its management; Radioactive pollution and its control; Solid waste management; Major environmental issues in Bangladesh; Arsenic pollution in Bangladesh; Pesticides pollution and its management in Bangladesh; Environmental frame work and policy in Bangladesh; National environmental legislations and guidelines; Global environmental issues and the international conventions & earth summits held on environment.

DETAIL DESCRIPTION

- 1 Understand the basic concepts of environment.**
 - 1.1 Define environment.
 - 1.2 Mention the main components of environment.
 - 1.3 Describe the environment of a house.
 - 1.4 Describe natural environment, man-made environment and social environment.
 - 1.5 Mention the functions of environment.
 - 1.6 Define the following environmental terms :

Marine environment, Estuarine environment, Terrestrial environment, Freshwater environment, Environmental education, Nutrients, Material particles, Solar capital, Earth capital, Mangrove forest, Photo-chemical oxidant, Population growth, Zero

population growth, Sustainable society, Pollutant, Contaminant, Receptor, Sink, Pathways of pollutant, Speciation.

2 Understand ecology and eco-systems.

- 2.1 Define ecology and eco-system.
- 2.2 Describe the biotic and abiotic components of eco-system.
- 2.3 Explain how does eco-system work.
- 2.4 Mention the range of tolerance in eco-system.
- 2.5 Mention the stability of eco-system.
- 2.6 Describe the following bio-geochemical cycles of eco-system.
 - a) Carbon cycle
 - b) Nitrogen cycle
 - c) Phosphorus cycle
 - d) Sulphur cycle.
- 2.7 Describe the following ecological terms:
Food chain, Food web, Biomass, Ecological pyramid, Pyramid of biomass, Pyramid of energy, Bio-concentration, Bio-magnification, Restoration ecology.

3 Understand the air and the atmospheric regions.

- 3.1 Define the following terms:
Air, lithosphere, hydrosphere, biosphere, atmosphere, troposphere, stratosphere, mesosphere, thermosphere, ionosphere and exosphere.
- 3.2 Mention the average composition of the atmosphere at the sea level.
- 3.3 Describe the chemical species and particulates present in the atmosphere.
- 3.4 Explain that atmosphere of the earth is an oxidizing environment.
- 3.5 Describe the chemical reactions occur in the atmosphere.
- 3.6 Describe the ozone layer in the atmosphere and its importance.
- 3.7 Describe the filtration of solar radiation in the atmosphere.

4 Understand the toxic chemicals, gases, vapors, fumes, pesticides and microbails which are hazardous to environment.

- 4.1 Define toxic substance.
- 4.2 Make a list of toxic chemicals, gases, pesticides, microbailes, vapors and fumes which are hazardous to human life.
- 4.3 Make a list of naturally occurring toxicants.
- 4.4 Mention the names of main hazardous substances present in the atmospheres.
- 4.5 List the toxic elements found in water.

5 Understand the air pollution and its sources & effects.

- 5.1 Define air pollution.
- 5.2 Mention the composition of clean dry atmospheric air.
- 5.3 List the air pollutants.

- 5.4 Describe the sources of air pollution.
 - 5.5 Describe the effects of air pollution on human health, animals, plants and non-living things.
 - 5.6 Explain the formation of photo-chemical smog and its effect.
 - 5.7 Describe the acid rain and its causes & effect on eco-system.
 - 5.8 Describe the disasters of major air pollution in the world mentioning location, causes and effects.
- 6 Understand the “Green House Effects” and depletion of Ozone layer.**
- 6.1 Mention green house gases.
 - 6.2 Describe the green house effects.
 - 6.3 Mention the predictions of global warming and climate changes.
 - 6.4 Describe ozone layer depletion and its causes.
 - 6.5 Mention the steps to be taken in Bangladesh for the protection of ozone layer depletion and green house effect.
- 7 Understand the control of air pollution at the emission of the pollutant sources.**
- 7.1 Mention the method of control of air pollution by the correction of pollution sources.
 - 7.2 Describe the method of cleaning air or gaseous effluents by gravitational setting chamber.
 - 7.3 Describe the method of air and gas cleaning by cyclone separator.
 - 7.4 Describe the method of air or gaseous effluent cleaning by wet scrubber.
 - 7.5 Describe the method of air cleaning by fabric filter system.
 - 7.6 Describe the method of air and gas cleaning by electrostatic precipitator.
 - 7.7 Describe the method of cleaning air gas by centrifugal scrubber.
 - 7.8 Describe the method of cleaning exhaust air of automobile vehicle by catalytic converter.
- 8 Understand the water pollution and its sources & effects.**
- 8.1 Define water pollution.
 - 8.2 Mention the specification of ideal water as per recommendation of the World Health Organization (WHO).
 - 8.3 List the different types of water pollutants.
 - 8.4 Describe the sources of water pollution.
 - 8.5 Describe the effects of water pollution on human health, animal, plants and environment.
 - 8.6 Mention the major water pollution disasters of the world mentioning location, causes and effects on environment.
- 9 Understand the monitoring of water pollution.**
- 9.1 Define the following terms:
 - (i) Dissolved oxygen (DO).

- (ii) Biochemical oxygen demand (BOD).
 - (iii) Chemical oxygen demand (COD).
 - (iv) Total organic carbon (TOC).
 - (v) Threshold limit value (TLV).
- 9.2 Describe the method of determination of dissolved oxygen (DO) in a sample of water.
- 9.3 Describe the method of determination of biochemical oxygen demand (BOD) in a sample of water.
- 9.4 Describe the method of determination of chemical oxygen demand (COD) in a sample of water.
- 9.5 Describe the method of determination of total organic carbon (TOC) in a sample of water.
- 9.6 Mention the method of determination of nitrogen and phosphorus in a sample of water.
- 9.7 Mention the method of determination of pH value of water.
- 9.8 Mention the methods of determination of microbials present in a sample of water.
- 10 Understand the waste water treatment.**
- 10.1 Define the primary treatment, secondary treatment and tertiary treatment of waste water.
- 10.2 Mention the methods of primary and secondary treatment of industrial waste water.
- 10.3 Describe the activated sludge process of industrial waste water treatment.
- 10.4 Describe the trickling filters method of industrial waste water treatment.
- 10.5 Describe the method of sludge treatment in biological waste water treatment plant.
- 10.6 Describe the methods of removal of suspended solid, nitrogen and phosphorus from waste water.
- 10.7 Mention the advanced biological system for waste water treatment.
- 10.8 Describe the chemical oxidation method of waste water treatment.
- 11 Understand the sound pollution and its control.**
- 11.1 Define sound, sound wave and sound pollution.
- 11.2 Mention the classification of sound.
- 11.3 Mention the sources of sound pollution.
- 11.4 Describe the effect of sound pollution on human health.
- 11.5 Describe the causes of sound pollution.
- 11.6 Mention the scale of measuring sound intensity.
- 11.7 Describe the methods of control of sound pollution.
- 12 Understand the soil pollution and its management.**
- 12.1 Define soil pollution.
- 12.2 List the different soil pollution.

- 12.3 Describe the classification of soil pollution.
- 12.4 Mention the sources of soil pollution.
- 12.5 Mention the damaging effect of soil pollution.
- 12.6 Describe the effect of soil pollution on human health.
- 12.7 Describe the management of soil pollution.
- 13 Understand the radioactive pollution and its control.**
 - 13.1 Define radioactive pollution.
 - 13.2 Mention the sources of radioactive pollution.
 - 13.3 Describe the causes of radioactive pollution.
 - 13.4 Mention the environmental pollution from radioactive waste.
 - 13.5 Describe the effect of radioactive pollution on human health.
 - 13.6 Describe the method of control of radioactive pollution.
- 14 Understand the solid waste management.**
 - 14.1 Define solid waste.
 - 14.2 List the sources of solid waste.
 - 14.3 Mention the classification of solid waste.
 - 14.4 Mention the methods of collection of solid waste.
 - 14.5 Describe the potential method of disposal of solid waste.
 - 14.6 Describe the recycling of solid wastes.
 - 14.7 Describe waste management by vermi composting.
 - 14.8 Mention the waste management strategies in Bangladesh.
- 15 Understand the major environmental issues in Bangladesh.**
 - 15.1 List the major environmental issues in Bangladesh.
 - 15.2 Describe the causes of flood, cyclone, tidalbore, soil erosion, droughts, earthquakes and salinity in Bangladesh.
 - 15.3 Mention the population growth in Bangladesh and its effect in the environment of the country.
 - 15.4 Describe the marine, river and wet land pollution in Bangladesh mentioning its causes & effects in the environment.
 - 15.5 Describe deforesting and its effect in biodiversity in the country.
 - 15.6 Describe the causes of increasing salinity in Bangladesh and its effect in the environment.
 - 15.7 Mention the causes of increasing draught in Bangladesh and its effect in the country.
- 16 Understand the arsenic pollution in Bangladesh.**
 - 16.1 Mention the arsenic pollution of water in Bangladesh.
 - 16.2 Describe the effects of arsenic pollution in water on human health and on environment in Bangladesh.
 - 16.3 Describe the causes of arsenic in ground and underground water.
 - 16.4 Describe the quality standard of arsenic contaminated water.
 - 16.5 Describe the tests for arsenic in water.
 - 16.6 Describe the remedial measure of arsenic in water.

- 16.7 Describe the principle of construction of a Arsenic Removal Plant (ARP) from arsenic contaminated water.
- 17 Understand the pesticide pollution in Bangladesh and its management.**
- 17.1 Define pesticide.
- 17.2 Make a list of pesticides.
- 17.3 Mention the causes of pesticide pollution in Bangladesh.
- 17.4 Describe the effect of pesticide pollution in the environment.
- 17.5 Mention the bed effect of use of organo-chlorine insecticide on environment.
- 17.6 Describe the mode of action of DDT, toxaphenes, heptachlor, aldrion dieldrin and derivatives of phosphoric acid and their effects on environment.
- 17.7 Mention the modern insecticides and their effects on environment.
- 17.8 Describe the management of pesticides control.
- 18 Understand the environmental frame work and policy in Bangladesh.**
- 18.1 List the name of the organization and research institutions engaged for the environmental research in Bangladesh.
- 18.2 Describe the environmental frame work in Bangladesh.
- 18.3 Describe the functions of Environment Management Action Plan (NEMAP).
- 18.4 Describe the environment policies and laws of Bangladesh.
- 18.5 Mention the Environmental Impact Assessment (EIA) and its importance in Bangladesh context.
- 18.6 Describe the activities of directorate of environment of Bangladesh.
- 19 Understand the national environmental legislations and guidelines.**
- 19.1 Mention environmental act and legislations prescribed for air and water quality.
- 19.2 Describe environmental act prescribed for industries in Bangladesh.
- 19.3 Describe the guide lines of environment prescribed for industries in Bangladesh.
- 19.4 Describe environmental act prescribed for solid waste deposit.
- 19.5 Describe environmental act prescribed for forest park and wild-life preservation in the country.
- 19.6 Describe environmental act prescribed for urbanization in the country.
- 20 Understand the global environmental issues and the international conventions & earth summits held on environment.**
- 20.1 Mention the main issues of global environment.
- 20.2 Describe the conventions and earth summits held on environment in different places of the world.
- 20.3 Mention the global steps taken to minimize green house effect and ozone layer depletion.

- 20.4 Mention the causes of raising water level of global sea and its consequences.
- 20.5 Describe the global issue on sharing of surface water and its importance.
- 20.6 Describe global environmental quality standard.

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AIMS

- To be able to understand the basic concepts of communication and its process & forms.
- To be able to perform the information handling.
- to be able to perform in writing application for job, letter and forms of correspondences

SHORT DESCRIPTION

Basic concepts of communication; Communication model & feedback; Types of communication; Methods of communication; Formal & informal communication; Essentials of communication; Report writing; Technical report; Information handling; Office management; Communication through correspondence; Official and semi-official letters.

DETAIL DESCRIPTION

- 1 Understand the basic concepts of communication and its process & scope.**
 - 1.1 Define communication.
 - 1.2 Define business communication.
 - 1.3 Describe the scope of business communication.
 - 1.4 State the objectives of business communication.
 - 1.5 Discuss the essential elements of communication process.
- 2 Understand the communication model and feedback.**
 - 2.1 Define communication model.
 - 2.2 State the business functions of communication model.
 - 2.3 Define feedback.
 - 2.4 State the basic principles of effective feedback.
 - 2.5 Explain the essential feedback to complete communication process.
- 3 Understand the types of communication.**
 - 3.1 Explain the different types of communication.
 - 3.2 Describe the advantages and disadvantages of upward communication.
 - 3.3 Describe the advantages and disadvantages of downward communication.
 - 3.4 Distinguish between upward and downward communication.
 - 3.5 Define two-way communication.
 - 3.6 Describe the advantages and disadvantages of two-way communication.
- 4 Understand the methods of communication.**
 - 4.1 Define communication method.
 - 4.2 Discuss the various methods of communication.
 - 4.3 Describe the advantages and disadvantages of oral communication.
 - 4.4 Describe the advantages and disadvantages of written communication.
 - 4.5 Distinguish between oral and written communication.
- 5 Understand the formal and informal communication.**
 - 5.1 Define formal communication.
 - 5.2 Describe the advantages and disadvantages of formal communication.
 - 5.3 Define informal communication.
 - 5.4 Discuss the advantages and disadvantages of informal communication.
 - 5.5 Distinguish between formal and informal communication.
- 6 Understand the essentials of communication.**
 - 6.1 Describe the essential features of good communication.
 - 6.2 Describe the barriers of communication.
 - 6.3 Discuss the means for overcoming barriers to good communication.
- 7 Understand the report writing.**
 - 7.1 Define report.
 - 7.2 Define business report.
 - 7.3 State the essential qualities of a good report.

- 7.4 Describe the factors to be considered while drafting a report.
- 7.5 Explain the components of a report.
- 7.6 Describe the classification of report.
- 8 Understand the technical report.**
 - 8.1 Define technical report.
 - 8.2 Mention the uses of technical report.
 - 8.3 Describe the types of technical report.
 - 8.4 Distinguish between a technical report and general report.
- 9 Understanding the information handling.**
 - 9.1 Define data, facts and events.
 - 9.2 State the sources of information.
 - 9.3 Describe the channel of communication relevant to information.
 - 9.4 Define management information systems (MIS).
 - 9.5 Discuss the channel of presentation of data in the report.
- 10 Understand the office management.**
 - 10.1 Define office and office work.
 - 10.2 State the characteristics of office work.
 - 10.3 Define filing and indexing.
 - 10.4 Discuss the methods of filing.
 - 10.5 Discuss the methods of indexing.
 - 10.6 Distinguish between filing and indexing.
- 11 Understand communication through correspondence.**
 - 11.1 State the types of correspondence.
 - 11.2 Define commercial letter.
 - 11.3 Mention the objects of commercial letter.
 - 11.4 State the different parts of a commercial letter.
 - 11.5 Distinguish between commercial letter and personal letter.
- 12 Understand the official and semi-official letters.**
 - 12.1 Define official letter and semi-official letter.
 - 12.2 Distinguish between official letter and semi-official letters.
 - 12.3 Prepare the following letters :
interview letter, appointment letter, joining letter and application for employment.
 - 12.4 Prepare the complain letters.
 - 12.5 Draft a tender notice to be published in a daily newspaper.

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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.

SHORT DESCRIPTION

Basic concepts of management; Principles of management; Scientific management; Organization; Span of supervision; Motivation; Personnel management and human relation; Staffing and manpower development; Training of staff; Job evaluation and merit rating; Industrial dispute; Budget & budgetary control; Concept of leadership.

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.
- 1.5 Discuss the terms : administration, organization, management.
- 1.6 State the activity level of industrial management from top personnel to workmen.
- 1.7 Describe the reaction among administration, organization & management.
- 1.8 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 each organization.
- 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 personnel management and human relation.**
 - 6.1 Define personnel management.
 - 6.2 Describe the scope of personnel management.
 - 6.3 Discuss the importance of personnel management.
 - 6.4 Discuss the functions of personnel management.
 - 6.5 Discuss the disadvantages of personnel management in Bangladesh.
 - 6.6 Describe the way of solving problems of personnel management in Bangladesh.
- 7 Understand the staffing and manpower development.**
 - 7.1 Define staffing.
 - 7.2 Discuss the importance and necessity of staffing.
 - 7.3 Define recruitment and selection of employees.
 - 7.4 Describe various sources of recruitment of employees.
 - 7.5 Describe the various methods of selection of employees.
 - 7.6 Discuss the advantages and disadvantages of internal sources of recruitment.
 - 7.7 Discuss the disadvantages of external sources of recruitment.
 - 7.8 Define manpower planning.

- 7.9 Describe advantages and disadvantage of manpower planning.
- 8 Understand the need for training of staff.**
- 8.1 Define training and orientation of employee.
- 8.2 Discuss the importance and necessity of training.
- 8.3 Describe the process of training.
- 8.4 Discuss the various methods of training of workmen, technicians and executive personnel.
- 8.5 Explain the benefits of training in business and industrial concerns.
- 9 Understand the concept of job evaluation and merit rating.**
- 9.1 Explain the terms : Task of a employee, Job evaluation, Job description, Job specification, Personnel specification, Merit rating, Job analysis
- 9.2 Describe the methods of job evaluation and merit rating.
- 9.3 Discuss the advantages and disadvantages of job evaluation and merit rating.
- 9.4 Distinguish between job evaluation and merit rating.
- 10 Understand the concept of industrial dispute.**
- 10.1 Define industrial dispute.
- 10.2 Discuss the elements of industrial dispute.
- 10.3 Describe the causes of industrial dispute.
- 10.4 Discuss the modes of dispute settlement in Bangladesh.
- 10.5 Explain the terms:
- Strike.
 - Lock-out
 - Picketing
 - Gherao
 - Go slow.
- 11 Understand the concepts of budget and budgetary control.**
- 11.1 Define budget and budgetary control
- 11.2 Describe the different types of budget.
- 11.3 Discuss the objectives of budget.
- 11.4 Discuss the advantages and disadvantages of budgetary control.
- 11.5 State the pre-requisites for successful budgetary control.
- 12 Understand the concept of leadership.**
- 12.1 Define leadership.
- 12.2 Discuss the importance and necessity of leadership.
- 12.3 Discuss the functions of leadership.
- 12.4 Identify the types of leadership.
- 12.5 Describe the qualities of a leader.
- 12.6 Distinguish between autocratic leader and democratic leader.

