



BANGLADESH TECHNICAL EDUCATION BOARD

Agargaon, Sher-E-Bangla Nagar

Dhaka-1207.

**04-YEAR DIPLOMA IN ENGINEERING CURRICULUM
COURSE STRUCTURE & SYLLABUS
(PROBIDHAN-2022)**

MECHANICAL TECHNOLOGY

TECHNOLOGY CODE: 70

5TH SEMESTER

(Effective from 2022-2023 Academic Sessions)

DIPLOMA IN ENGINEERING CURRICULUM COURSE STRUCTURE

(PROBIDHAN-2022)

TECHNOLOGY NAME: MECHANICAL TECHNOLOGY (70)

(5th SEMESTER)

Sl. No.	Subject		Period Per Week		Credit	Marks Distribution						Grand Total
						Theory Assessment			Practical Assessment			
	Code	Name	Theory	Practical		Continuous	Final	Total	Continuous	Final	Total	
1	25852	Industrial Management	2	-	2	40	60	100	-	-	-	100
2	27051	Fluid Mechanics & Machineries	3	3	4	60	90	150	25	25	50	200
3	27052	Mechanical Estimating & Costing	2	3	3	40	60	100	25	25	50	150
4	27053	Advanced Welding-I	2	6	4	40	60	100	50	50	100	200
5	27054	Foundry & Pattern Making	2	3	3	40	60	100	25	25	50	150
6	27055	Manufacturing Process	3	-	3	60	90	150	-	-	-	150
7	28567	Programming in C	2	3	3	40	60	100	25	25	50	150
Total			16	18	22	320	480	800	150	150	300	1100

Subject Code	Subject Name	Period per Week		Credit
25852	INDUSTRIAL MANAGEMENT	T	P	C
		2	0	2

Rationale	<p>As mid-level manager, engineering diploma graduates are responsible for proper and most efficient interaction of 6 M'S: man, machine, material, money, method (SOP or process) and market with a focus that will depend on their position in the organization (production, planning, quality, maintenance, design, etc.).</p> <p>They first need to understand the type of management and organization they work in. As they work directly or indirectly with manufacturing, therefore they need to have knowledge, skills and attitudes on production, planning, productivity improvement, new systems such as lean manufacturing and understand how production integrates in the overall supply chain management.</p> <p>They deal with people either as a supervisor, assistant manager or by leading transversal projects, they should know their role concerning human resources management and development. In their daily work, they must use a suitable leadership style, assign and monitor work, solve problems, support motivation to change of their teams when they implement new methods and systems.</p>
Learning Outcome (Theoretical)	<p>After undergoing the subject, students will be able to:</p> <ul style="list-style-type: none"> <input type="checkbox"/> State the roles and responsibilities of a mid-level manager within the organization <input type="checkbox"/> Differentiate various management systems and organizations <input type="checkbox"/> Describe the manufacturing process ensuring productivity, quality, cost and safety <input type="checkbox"/> State the types of production planning <input type="checkbox"/> Explain productivity improvement factors while controlling cost <input type="checkbox"/> Describe new trends of production management systems <input type="checkbox"/> Identify mid-level manager roles in the human resources management and development <input type="checkbox"/> Select the suitable leadership style depending on the situations and people <input type="checkbox"/> Identify the steps of work assignment based on goals to achieve while supporting changes <input type="checkbox"/> Describe the steps of problem solving and decision making

DETAIL DESCRIPTION (THEORY):

Unit	Topics with Contents	Class (1 Period)	Final Marks
1.	<p>FUNDAMENTALS OF ORGANIZATION</p> <p>1.1 Explain the purpose of an organization. 1.2 Define management organization. 1.3 Describe various types and features of organization structures. 1.4 Explain authority, responsibility, duties and delegation of authority. 1.5 Define span of supervision.</p>	2	4
2.	<p>FUNDAMENTALS OF MANAGEMENT</p> <p>2.1 Explain the functions of management. 2.2 Relate administration, organization and management. 2.3 Describe different types of management and in which context they apply. 2.4 Define the specificities of industrial management.</p>	2	4
3.	<p>PRODUCTION MANAGEMENT</p> <p>3.1 Define production management . 3.2 State functions of production management. 3.3 Describe “5p”. 3.4 Mention applications of “5p”. 3.5 Define cost control-methods. 3.6 Define inventory & inventory control. 3.7 Describe the fundamentals of maintenance management. 3.8 Explain the importance of quality system. 3.9 Explain the components of quality system</p>	5	8
4	<p>PRODUCTIVITY IMPROVEMENT</p> <p>4.1 Define Productivity. 4.2 List factors affecting industrial productivity. 4.3 Describe productivity improvement techniques. 4.4 Describe the lean manufacturing approach. 4.5 Explain the concept of Just in Time.</p>	3	6
5	<p>PLANNING</p> <p>5.1 Discuss importance of planning. 5.2 Explain the steps in planning. 5.3 Explain the factors affecting on planning. 5.4 State different types of production planning and control. 5.5 Describe the way to manage personal time.</p>	4	7
6	<p>SUPPLY CHAIN MANAGEMENT</p>	3	4

Unit	Topics with Contents	Class (1 Period)	Final Marks
	6.1 Define supply chain management. 6.2 Explain the components of supply chain management. 6.3 Explain production integration into supply chain management.		
7.	HUMAN RESOURCES MANAGEMENT AND DEVELOPMENT (HRM-HRD) 7.1 Describe the main functions in human resources management (HRM). 7.2 Describe the main functions in human resources development (HRD). 7.3 Explain the role of manager in the recruitment process. 7.4 Explain the role of manager in the training process. 7.5 Explain the role of manager in the performance management system. 7.6 Mention the components of compensation and benefits system.	3	6
8.	LEADING A TEAM 8.1 Define leadership. 8.2 Identify personality traits impacting leadership style. 8.3 Discuss the types of leadership. 8.4 Define motivation and motivational cycle. 8.5 State the importance of motivation. 8.6 List motivation drivers based on Maslow, Herzberg adapted to various generations 8.7 State concepts of Theory-X, Theory-Y and Theory-Z	3	6
9.	WORK ASSIGNMENT 9.1 List different types of leadership styles. 9.2 Describe the leadership style adapted to the work assignment and delegation. 9.3 State SMART goal. 9.4 Set SMART goals to support work assignment. 9.5 Identify ways to reduce resistance to change during work assignment.	4	8
10.	PROBLEM SOLVING AND DECISION MAKING 10.1 Mention the steps of problem solving. 10.2 Explain tools used to analyze and solve problem addressing the 5M components. 10.3 Define decision making. 10.4 Discuss different types of decision-making process. 10.5 Describe the steps in decision making.	3	7
	Total	32	60

Necessary Resources (Tools, equipment and Machinery):

SI	Item Name	Quantity (piece/s)
01	Case studies, examples, exercises related documents	One for each student
02	Project templates	One for each student

Recommended Books:

SI	Book Name	Writer Name	Publisher Name & Edition
01.	Principles of Management	Dr. Md. Mainul Islam and Dr. Abdul Awal Dhan,	Bangladesh Open University.
02.	Personnel Management and Industrial Relation.	Mohammad Mohiuddin	NIDS Publication Co, Dhaka.
03.	Production Operations Management: The Handbook	Ronald P Bizzle Jr	Independently published (January 31, 2023)
04.	How To Implement Lean Manufacturing, Second Edition 2nd Edition	Lonnie Wilson	McGraw Hill; 2nd edition (March 22, 2015)
05.	The Toyota Way, Second Edition: 14 Management Principles from the World's Greatest Manufacturer Hardcover	Jeffrey K Liker	McGraw Hill; 2nd edition (December 1, 2020)
06.	Fast er, Bet ter, Cheaper i n the H istory of M anuf act ur i ng 1st Edition	Chr i st oph Roser	Product i vi ty Pr; 1st edition (August 5, 2016)
07.	Suppl y Chai n Management , I nvent or y Cont rol , Human Resource Management , and Cust omer ser vi ce (Loui s Bevoc Ser i es of Educat i onal and I nf or mat i onal Books)	Loui s Bevoc	Creat eSpace I ndependent Publ i shi ng Pl at f or m (Sept ember 4, 2016)
08.	Bul l et pr oof Pr obl em Sol vi ng: The One Ski l l That Changes Everyt hi ng	Char l es Conn	WI ey; 1st edition (Mar ch 6, 2019)
09.	The M i ni at ur e Gui de t o Cri t i cal Thi nki ng Concept s and Tool s	Ri char d Paul and Li nda El der	The Foundat i on f or Cri t i cal Thi nki ng; E ight h edition (Sept ember 20, 2019)
10.	Leadership and the One Minute Manager: Increasing Effectiveness Through Situational Leadership	Ken Blanchard, Patricia Zigarmi, Drea Zigarmi	William Morrow; Updated edition (October 15, 2013)
11.	Effective Delegation of Authority: A (Really) Short Book for New Managers	Hassan Osman	Independently published (May 7, 2019)
12.	The Human Element: Overcoming the Resistance That Awaits	Loran Nordgren, David Schonthal	Wiley; 1st edition (September 28, 2021)
13.	The 7 Habits of Highly Effective People	Stephen R. Covey	Free Press (1989)
14.	ব্যবস্থাপনা	মোহাম্মদ খালেবুজ্জামান	দি যমুনা পাবলিশার্স
16.	কলেজে আরও ভালো কীভাবে করা যায়	সম্পাদকমন্ডলী	নায়েম, ঢাকা

17.	শিল্প প্রতিষ্ঠান উৎকর্ষ অর্জন	সম্পাদকমন্ডলী	নায়েম, ঢাকা
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Website References:

SI	Web Link	Remarks
01.	www.coachinforleaders	Podcast on leadership skills
02.	https://essentialcomm.com/	Podcast on coaching
03.	https://www.manager-tools.com/	Podcast on management
04.	https://www.shrm.org/	Website of the most important HR association in USA
05.	https://www.makingchips.com/	Podcast on manufacturing

SUBJECT CODE	SUBJECT NAME	PERIOD PER WEEK		CREDIT
		T	P	
27051	FLUID MECHANICS & MACHINERY	3	3	4

Rationale	<p>Fluid mechanics deals with the study of all fluids under static and dynamic situations. This is a branch of continuous mechanics that deals with a relationship between forces, motions, and static conditions. Studying fluid mechanics and machinery in mechanical engineering is to gain the knowledge and tools necessary to analyze, design and optimize systems where fluids are a key component. By understanding fluid behavior, diploma engineers can improve energy efficiency, enhance performance and ensure the safety and reliability of engineering systems.</p> <p>This course will introduce the students with fluid, fluid properties and unit conversion, pressure gauges, Bernoulli's theorem, fluid flow through orifice and mouthpiece, operation of water turbine, reciprocating pump and centrifugal pump, Pascal's law, working procedure of hydraulic devices, hydraulic and pneumatic system. The students should acquire knowledge, skills and attitude regarding fluid mechanics and machinery, hydraulics, and pneumatic system.</p>
Learning Outcome (Theoretical)	<p>After undergoing the subject, students will be able to</p> <ol style="list-style-type: none"> 1. State fluid, fluid properties with unit conversion. 2. Illustrate different types of pressure gauges. 3. Illustrate fluid flow through pipe. 4. Explain Bernoulli's theorem. 5. Describe fluid flow through orifice and mouthpiece. 6. Interpret viscous flow and impact of jet. 7. Explain friction losses in pipe. 8. Explain the operation of water turbine, reciprocating pump and centrifugal pump. 9. State Pascal's law with applications. 10. Describe the working procedure of hydraulic devices. 11. Explain the process of hydraulic and pneumatic system.
Learning Outcome (Practical)	<p>After undergoing the subject, students will be able to</p> <ol style="list-style-type: none"> 1. Calibrate a bourdon tube pressure gauge with a dead weight gauge. 2. Verify Bernoulli's equation by Bernoulli's apparatus equipped with a hydraulic test bench. 3. Determine the discharge of water through a pipe by the venturi meter or orifice meter equipped with a hydraulic test bench. 4. Determine the loss of head due to friction by fluid friction apparatus. 5. Test the performance of a reciprocating pump with the reciprocating pump test rig. 6. Test the performance of a centrifugal pump with the centrifugal pump test rig. 7. Test the performance of an impulse turbine with the impulse (Pelton wheel) turbine test rig. 8. Determine the leverage and mechanical advantage of a hydraulic press. 9. Identify the different components of a two-stage reciprocating air compressor and operate the compressor. 10. Perform automatic operation of the double-acting cylinder in a single cycle using the limit switch.

DETAILED SYLLABUS (THEORY)

Unit.	Topics with Contents	Class (1Period)	Final Marks
1.	INTRODUCTION TO FLUID 1.1 Define fluid. 1.2 Classify fluid. 1.3 Compare among liquid, vapor, and gas. 1.4 Define hydraulics and hydraulic machinery. 1.5 Outline the importance of hydraulics and hydraulic machinery. 1.6 State the branches of hydraulics. 1.7 Mention the applications of hydraulics and hydraulic machinery in the engineering field.	02	04
2.	FLUID PROPERTIES 2.1 List the properties of fluids. 2.2 Define density, specific weight, surface tension, capillary, viscosity, and fluid pressure. 2.3 Define atmospheric pressure, gauge pressure, and absolute pressure. 2.4 Relate among atmospheric pressure, gauge pressure, and absolute pressure. 2.5 Derive the formulae to find total pressure on the immersed surface at horizontal, inclined, and vertical positions. 2.6 Solve the problems on static fluid pressure.	03	05
3.	FLUID PRESSURE GAUGES 3.1 Define pressure gauge. 3.2 State the different types of pressure gauges. 3.3 Distinguish between simple manometer and differential manometer. 3.4 Describe the working principle of different types of pressure gauges. 3.5 Mention the application of different pressure gauges. 3.6 Solve the problems related to the measurement of fluid pressure.	04	07
4.	FLUID FLOWS THROUGH PIPES 4.1 State different types of fluid flow. 4.2 State continuity equation of flow. 4.3 Define flow rate. 4.4 Derive the formula of flow rate. 4.5 Solve the problems on continuity equation of flow.	03	06
5.	BERNOULLI'S EQUATION 5.1 Define head, pressure head, velocity head, datum head, and total head. 5.2 State Bernoulli's equation of fluid. 5.3 Derive Bernoulli's equation of fluid. 5.4 Outline the application of Bernoulli's equation of fluid. 5.5 Point out the limitation of Bernoulli's equation. 5.6 Mention the function of the venture meter, orifice meter and pitot tube. 5.7 Describe the operation of venture meter, orifice meter and pitot tube. 5.8 Derive the formula to measure the discharge of fluid flow through the venture-meter. 5.9 Drive the formula to measure the discharge of fluid flow through the orifice-meter and the pitot tube. 5.10 Solve the problems on fluid flow through a pipe, Bernoulli's equation, venture-meter, orifice-meter and pitot tube.	05	08

6.	<p>FLOW THROUGH ORIFICES</p> <p>6.1 Define orifice. 6.2 Classify orifice. 6.3 State hydraulic coefficients. 6.4 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. 6.5 Relate C_c, C_v, and C_d. 6.6 Calculate different hydraulic coefficient. 6.7 Solve the problems related to orifice.</p>	03	06
7.	<p>FLOW THROUGH MOUTHPIECES</p> <p>7.1 Define mouthpieces. 7.2 Classify mouthpieces. 7.3 Deduce the formulae to calculate discharge of fluid flow through different types of mouthpieces. 7.4 State head losses of flowing liquid in a pipe. 7.5 List the causes of head loss of liquid flow. 7.6 Deduce the formulae to calculate the head loss due to friction, sudden enlargement, sudden contraction and obstruction in the pipe. 7.7 Deduce the formulae to calculate the head loss due to friction (Darcy's and Cheay's formulae). 7.8 Solve the problems related to head losses and discharge of fluid flow through mouthpieces.</p>	04	06
8.	<p>VISCOUS FLOW</p> <p>8.1 Define viscosity. 8.2 Mention the units of viscosity. 8.3 Define ideal fluid, real fluid, Newtonian fluid and non-Newtonian fluid. 8.4 Distinguish between the laminar flow and turbulent flow. 8.5 State Reynold's number. 8.6 Solve the problems related to viscosity.</p>	02	04
9.	<p>THE IMPACT OF THE JETS</p> <p>9.1 Define Jet. 9.2 State the impact of jet. 9.3 Deduce the formula to calculate the force of a jet impinging on a flat fixed vertical plate, inclined plate, and hinged plate. 9.3 Solve the problems on the impact of jets related to flat fixed plates, inclined fixed plates, and hinged plates.</p>	03	05
10.	<p>WATER TURBINES</p> <p>10.1 State water turbine. 10.2 Classify water turbine. 10.3 Illustrate the principle of impulse and reaction water turbine. 10.4 Compare between impulse and reaction turbine. 10.5 Describe the construction of Pelton, Kaplan, and Francis water turbine. 10.6 Describe the operation of Pelton, Kaplan, and Francis water turbine. 10.7 State the specific speed of turbine. 10.8 Describe the governing system of impulse and reaction turbine. 10.9 Define draft tube. 10.10 Classify draft tube.</p>	03	06
11.	<p>RECIPROCATING PUMPS</p> <p>11.1 Define reciprocating pump.</p>	03	06

	<p>11.2 Classify reciprocating pump.</p> <p>11.3 List the parts of reciprocating pump.</p> <p>11.4 Describe the operation of different types of reciprocating pump.</p> <p>11.5 Define slip of reciprocating pump.</p> <p>11.6 Mention the function of an air vessel in a single-acting and double acting reciprocating pump.</p> <p>11.7 Describe the operation of the suction side and discharge side air vessel in a single-acting and double acting reciprocating pump.</p> <p>11.8 Deduce the formula to calculate the discharge of reciprocating pump.</p> <p>11.9 Solve the problem related to the reciprocating pump.</p>		
12.	<p>CENTRIFUGAL PUMPS</p> <p>12.1 Define centrifugal pump.</p> <p>12.2 Classify centrifugal pump.</p> <p>12.3 Compare between centrifugal and reciprocating pump.</p> <p>12.4 List the parts of centrifugal pump.</p> <p>12.5 Describe the operation of different types of centrifugal pump.</p> <p>12.6 Define cavitation of centrifugal pump.</p> <p>12.7 Mention the required power to drive a centrifugal pump.</p> <p>12.8 Mention the efficiencies of centrifugal pump.</p> <p>12.9 State priming of a centrifugal pump.</p>	03	06
13.	<p>HYDRAULIC SYSTEMS</p> <p>13.1 Interpret oil power hydraulic system.</p> <p>13.2 State pascal law.</p> <p>13.3 Mention the application of pascal law.</p> <p>13.4 Describe the industrial applications of oil power hydraulic and pneumatic system.</p> <p>13.5 List the basic components of hydraulic system.</p> <p>13.6 Describe the function of components in a hydraulic circuit.</p> <p>13.7 Define filter, oil reservoir, coupling, motor and pump of hydraulic System.</p> <p>13.8 Describe the function of filter, oil reservoir, coupling, motor and pump of hydraulic system.</p> <p>13.9 Classify filters, seal, and sealing materials.</p> <p>13.10 Mention the function of oil reservoirs, coupling, motors, and pump.</p>	04	05
14.	<p>HYDRAULIC DEVICES</p> <p>14.1 State hydraulic devices.</p> <p>14.2 List the hydraulic devices.</p> <p>14.3 Mention the function of hydraulic press, hydraulic accumulator, hydraulic intensifier, hydraulic crane and hydraulic lift.</p> <p>14.4 Describe the construction of various hydraulic devices.</p> <p>14.5 Describe the operation of different types of hydraulic devices.</p>	02	06
15.	<p>COMPONENTS OF PNEUMATIC SYSTEMS</p> <p>15.1 Define pneumatic system.</p> <p>15.2 Illustrate oil power pneumatic system.</p> <p>15.3 State air compressors.</p> <p>15.4 List basic components of air compressor.</p> <p>15.5 Mention the function of air compressor.</p> <p>15.6 State different types of air cylinder.</p> <p>15.7 Mention the function of different types air cylinders.</p> <p>15.8 State the air filter, regulator, and lubricator.</p> <p>15.9 List the necessity of air filters, regulators, and lubricators in a pneumatic circuit.</p> <p>15.10 Describe the Installation, maintenance process, and application of air cylinders.</p>	04	10
	Total	48	90

DETAILED SYLLABUS (PRACTICAL)

Sl.	Experiment Name with procedure	Class (3 Period)	Marks (Continuous)
1.	<p>CALIBRATE A BOURDON TUBE PRESSURE GAUGE WITH A DEAD WEIGHT GAUGE.</p> <p>1.1 Collect bourdon tube pressure gage & dead weight gage. 1.2 Set proper tools & instruments in the working place. 1.3 Follow the working procedure for calibration of bourdon tube pressure gage dead weight gage. 1.4. Measure data. 1.5 Maintain the record of performed tasks.</p>	1	2
2.	<p>VERIFY BERNOULLI'S EQUATION BY BERNOULLI'S APPARATUS EQUIPPED WITH A HYDRAULIC TEST BENCH.</p> <p>2.1 Collect Bernoulli's apparatus equipped with a hydraulic test bench. 2.2 Set proper tools & instruments in the working place. 2.3 Follow the working procedure for verifying Bernoulli's apparatus equipped with a hydraulic test bench. 2.4 Measure data. 2.5 Maintain the record of performed tasks.</p>	2	2
3.	<p>DETERMINE THE DISCHARGE OF WATER THROUGH A PIPE BY THE VENTURI METER OR ORIFICE METER EQUIPPED WITH A HYDRAULIC TEST BENCH.</p> <p>3.1 Collect venturi meter with Hydraulic test bench. 3.2 Collect orifice apparatus equipped with Hydraulic test bench. 3.3 Set proper tools & instruments in the working place. 3.4 Follow the working procedure for verifying Bernoulli's apparatus equipped with a hydraulic test bench. 3.5 Determine the discharge of water using measuring data. 3.6 Maintain the record of performed tasks.</p>	1	2
4.	<p>DETERMINE THE LOSS OF HEAD DUE TO FRICTION BY FLUID FRICTION APPARATUS.</p> <p>4.1 Collect friction apparatus. 4.2 Set proper tools & instruments in the working place. 4.3 Follow the working procedure to determine the loss of head due to sudden enlargement of pipe by the manometer. 4.4 Determine the loss of different head loss due to sudden enlargement of the pipe by using measuring data. 4.5 Maintain the record of performed tasks.</p>	2	2
5.	<p>TEST THE PERFORMANCE OF A RECIPROCATING PUMP WITH THE RECIPROCATING PUMP TEST RIG.</p> <p>5.1 Collect a reciprocating pump with the reciprocating pump test rig. 5.2 Set proper tools & instruments in the working place. 5.3 Follow the working procedure to determine the performance of a reciprocating pump with the reciprocating pump test rig. 5.4 Determine the performance of a reciprocating pump with the reciprocating pump test rig. 5.5 Maintain the record of performed tasks.</p>	2	2
6.	<p>TEST THE PERFORMANCE OF A CENTRIFUGAL PUMP WITH THE CENTRIFUGAL PUMP TEST RIG.</p> <p>6.1 Collect the centrifugal pump with the centrifugal pump test rig. 6.2 Set proper tools & instruments in the working place. 6.3 Follow the working procedure to determine the performance of a</p>	2	3

	centrifugal pump with the centrifugal pump test rig. 6.4 Determine the performance of a centrifugal pump with the centrifugal pump test rig. using measuring data. 6.5 Maintain the record of performed tasks.		
7.	TEST THE PERFORMANCE OF AN IMPULSE TURBINE WITH THE IMPULSE (PELTON WHEEL) TURBINE TEST RIG. 7.1 Collect the impulse turbine with the impulse (Pelton wheel) turbine test rig. 7.2 Set proper tools & instruments in the workplace. 7.3 Follow the working procedure to determine the performance of the impulse turbine with the impulse (Pelton wheel) turbine test rig. 7.4 Determine the performance of the impulse turbine with the impulse (Pelton wheel) turbine test rig using measuring data. 7.5 Maintain the record of performed tasks.	1	3
8.	DETERMINE THE LEVERAGE AND MECHANICAL ADVANTAGE OF A HYDRAULIC PRESS. 8.1 Collect the apparatus. 8.2 Set proper tools & instruments in the workplace. 8.3 Follow the working procedure to determine the leverage and mechanical advantage of a hydraulic press. 8.4 Determine the leverage and mechanical advantage of a hydraulic press by using measuring data. 8.5 Maintain the record of performed tasks.	1	3
9.	OPERATE TWO-STAGE RECIPROCATING AIR COMPRESSOR 9.1 Collect the components of a two-stage reciprocating air compressor. 9.2 Identify components of a two-stage reciprocating air compressor. 9.3 Set proper tools & instruments in the workplace. 9.4 Follow the working procedure for the operation of a two-stage reciprocating air compressor. 9.5 Maintain the record of performed tasks.	2	3
10.	PERFORM AUTOMATIC OPERATION OF THE DOUBLE-ACTING CYLINDER IN A SINGLE CYCLE USING THE LIMIT SWITCH. 10.1 Collect the double-acting cylinder and air compressor. Collect Limit switch. 10.2 Set tools & instruments in the workplace. 10.3 Maintain the record of performed task.	2	3
Total		16	25

NECESSARY RESOURCES (TOOLS, EQUIPMENT'S AND MACHINERY):

SI	Item Name	Quantity
01	Bourdon tube pressure gauge with a dead weight gauge.	1 no
02	Hydraulic test bench.	2 no
03	Venturi meter and orifice meter equipped with a hydraulic test bench.	2 nos
04	Reciprocating pump test rig	01 no.
05	Centrifugal pump test rig	01 no.
06	Impulse turbine (Pelton wheel) test rig	01 no.
07	Hydraulic press.	02 no.
08	Two-stage reciprocating air compressor	01 no.
09	Double-acting cylinder and limit switch.	05 nos.

RECOMMENDED BOOKS:

Sl.	Book Name	Writer Name	Publisher Name & Edition
01	A textbook of Fluid Mechanics and Hydraulic Machines	Dr. R.K. Bansal	LAXMI Publications (P) Ltd. Ninth Edition
02	Fluid Mechanics	Dr. AK Jain	Khanna Publishers, 12 th Edition.
03	Fluid Mechanics and Machinery	C.P KOTHANDARAMAN R. RUDRAMOORTHY	
04	Hydraulics and Fluid Mechanics Machine	RS Khurmi	S. Chand & Co. Ltd. Twentieth Edition
05	Hydraulic and Pneumatic Power and Control Design, Performance and Application	Yeaple	McGraw Hill, New York.
06	Pneumatic Controls	Festo Didactic	Festo Didactic
07	Pneumatics Control: An Introduction to the Principles	Werner Deppert and Kurt Stoll	Vogel – Verlag

WEBSITE REFERENCES:

Sl	Web Link	Remarks
01	www.youtube.com	Search here with topics
02	www.google.com	Search here with topics

Board may rearrange marks distribution for question setting (If necessary)

SUBJECT CODE	SUBJECT NAME	PERIOD PER WEEK		CREDIT
		T	P	
27052	MECHANICAL ESTIMATING AND COSTING	2	3	3

Rationale	<p>Mechanical Estimating plays an essential role in construction projects as it helps to ensure that projects are completed within budget constraints. Costing is the process of calculating the overall cost of a construction project considering all aspects such as labor, materials, equipment costs and taxes. By employing mechanical estimating techniques, we can identify potential issues early on in a project's life cycle before they become major problems that could cause delays or result in additional expenses. The use of mechanical estimating also helps to maintain transparency between contractors and clients by providing detailed breakdowns of all expenses associated with a project.</p> <p>Estimation is to provide to volume of work for cost control and to see that the adequate of materials are explored during the execution of the project.</p>
Learning Outcome (Theoretical)	<p>After undergoing the subject, students will be able to</p> <ol style="list-style-type: none"> 1. State concept, scope and importance of mechanical estimating 2. Describe costing method 3. Illustrate the elements of cost 4. Explain the different components of cost 5. Explain different types of depreciation 6. State the formulae of mensuration of engineering parts 7. Illustrate the estimation of different types job 8. Interpret project planning 9. Describe the material cost economy
Learning Outcome (Practical)	<p>AFTER UNDERGOING THE SUBJECT, STUDENTS WILL BE ABLE TO</p> <ol style="list-style-type: none"> 1. Estimate the production cost of a Divider 2. Estimate the production cost of a Wrench 3. Estimate the production cost of a GI Mug 4. Estimate the production cost of a GI Funnel 5. Estimate the production cost of a GI Bucket 6. Estimate the production cost of a MS Center Punch 7. Estimate the production cost of a MS Ball Peen Hammer 8. Estimate the production cost of a MS V- Block 9. Estimate the production cost of a GI Tray 10. Estimate the production cost of a Cast Iron (CI) Bracket

DETAILED SYLLABUS (THEORY)

Unit	Topics with Contents	Class (1 Period)	Final Marks
1	<p>MECHANICAL ESTIMATING</p> <p>1.1 Define mechanical estimating, 1.2 Describe the scope of mechanical estimating. 1.3 Explain the importance of mechanical estimating. 1.4 Define administration, management, organization, bill of materials, idle time, scraps, waste, spoilage, by product, bonus and capital. 1.5 State organization set up of an estimating department. 1.6 Explain the function of mechanical estimating. 1.7 Describe the qualities of estimator. 1.8 Describe the estimating procedure. 1.9 Explain the constituents of estimation.</p>	04	09
2	<p>COSTING & COMPONENTS OF COST</p> <p>2.1 Define costing. 2.2 Explain costing. 2.3 Distinguish between estimating and costing. 2.4 Explain standard cost. 2.5 Describe costing methods of material. 2.6 Explain the three elements of cost control. 2.7 Define component of cost. 2.8 Classify components of cost. 2.9 Describe the components of cost. 2.10 Describe the steps to calculate the selling price.</p>	03	05
3	<p>ELEMENTS OF COST</p> <p>3.1 State the elements of cost, expenses, idleness, material cost and labor cost. 3.2 Explain different types of expenses. 3.3 Distinguish between direct and indirect material cost. 3.4 Describe the procedure of material costing. 3.5 Distinguish between direct and indirect labor cost. 3.6 Describe Time and Motion study. 3.7 Explain the procedure to find the labor cost. 3.8 Distinguish between direct and indirect expenses. 3.9 Distinguish between fixed and variable cost. 3.10 State the classification of idleness.</p>	03	08
	<p>DEPRECIATION</p> <p>4.1 Define depreciation.</p>	03	08

4	<p>4.2 Distinguish between depreciation and obsolescence.</p> <p>4.3 Explain the causes of depreciation.</p> <p>4.4 Describe different types of depreciation.</p> <p>4.5 State the formula of straight line, sinking fund, diminishing balance, annuity charging, sum of year's digits method and machine hour basis method for depreciation.</p> <p>4.6 Solve the problems on different types of depreciation.</p>		
5	<p>FORMULAE OF MENSURATION OF ENGINEERING PARTS</p> <p>5.1 Define mensuration of engineering parts.</p> <p>5.2 Describe formulae of mensuration to find the area of different engineering parts.</p> <p>5.3 State the formulae of mensuration to find the volume of different engineering parts.</p> <p>5.4 Discuss the steps of determining volume of different engineering parts.</p> <p>5.5 Describe the steps of determining weight of different engineering parts.</p> <p>5.6 Explain area of different geometrical figures.</p> <p>5.7 Interpret the volume of different geometrical figures.</p> <p>5.8 Explain the weight of different engineering parts.</p> <p>5.9 Solve the problems involving on volume and weight.</p>	04	07
6	<p>ESTIMATION OF FITTING SHOP'S JOB</p> <p>6.1 Estimate the material cost of divider.</p> <p>6.2 Estimate the material cost of wrench.</p> <p>6.3 Estimate the material cost of bucket.</p> <p>6.4 Estimate the material cost of funnel.</p> <p>6.5 Estimate the material cost of mug.</p> <p>6.6 Estimate the labor cost of Divider, Wrench, Bucket, funnel & Mug.</p> <p>6.7 Estimate the overhead cost of Divider, Wrench, Bucket, funnel & Mug.</p> <p>6.8 Estimate the total cost of Divider, Wrench, Bucket, funnel & Mug.</p>	03	03
7	<p>ESTIMATION OF MACHINE SHOP'S JOB</p> <p>7.1 Estimate the material cost of a Ball peen hammer.</p> <p>7.2 Estimate the material cost of a V- block.</p> <p>7.3 Estimate the material cost of a center punch.</p> <p>7.4 Estimate the labor cost of Ball peen hammer, V- block & center punch.</p> <p>7.5 Estimate the overhead cost of Ball peen hammer, V- block & center punch.</p> <p>7.6 Estimate total cost of the job of Ball peen hammer, V- block & center punch.</p> <p>7.7 Describe the methods of estimation.</p>	03	05

8	ESTIMATION OF WELDING SHOP'S JOB 1.1 Estimate the material cost of lap welding job. 1.2 Estimate the material cost of butt-welding job. 1.3 Estimate the material cost of pipe welding job. 1.4 Estimate the labor cost of butt, lap & pipe welding job. 1.5 Estimate the overhead cost of butt, lap & pipe welding job. 1.6 Estimate total cost of the job of butt, lap & pipe welding job. 1.7 Describe the methods of estimation.	03	04
9	ESTIMATION OF THE PATTERN & FOUNDRY SHOP'S JOB 9.1 Estimate the pattern cost of Pulley. 9.2 Estimate the pattern cost of Flange. 9.3 Estimate the pattern cost of Bracket. 9.4 Estimate the labor cost of Pulley, Flange, Bracket. 9.5 Estimate the overhead cost of Pulley, Flange, Bracket 9.6 Express the total cost of the Pulley, Flange, Bracket.	03	04
10	PROJECT PLANNING AND MATERIAL COST ECONOMY 10.1 State project planning. 10.2 Define material cost economic of project. 10.3 Describe the steps of project planning. 10.4 Explain Break Even Point. 10.5 Explain the role of material cost in the net profit of a production industry. 10.6 State the steps of material cost economy. 10.7 Estimate the selling price of a cast iron gear from pattern making to packaging.	03	07
	Total	32	60

DETAILED SYLLABUS (PRACTICAL)

SL No.	Experiment Name	Class (3 Period)	Marks (Continuous)
1	ESTIMATE THE PRODUCTION COST OF A DIVIDER 1.1 Sketch divider. 1.2 Measure the dimension of a divider. 1.3 Add necessary allowances. 1.4 Perform layout on raw materials. 1.5 Calculate weight of raw materials 1.6 Calculate price of raw materials 1.7 Add overhead charges to determine estimated production cost. 1.8 Maintain the record of performed task.	1	2

2	<p>ESTIMATE THE PRODUCTION COST OF A WRENCH</p> <p>2.1 Sketch Wrench 2.2 Measure the dimension of a Wrench. 2.3 Add necessary allowances. 2.4 Prepare Layout on raw materials by sketch. 2.5 Calculate weight of raw materials. 2.6 Calculate price of raw materials 2.7 Add overhead charges to determine estimated production cost. 2.8 Maintain the record of performed task.</p>	2	3
3	<p>ESTIMATE THE PRODUCTION COST OF A G.I. MUG</p> <p>3.1 Sketch Mug. 3.2 Measure the dimension of a Mug. 3.3 Identify the parts of a Mug. 3.4 Develop the surfaces of the parts 3.5 Layout on raw materials by sketch. 3.6 Add necessary allowances. 3.7 Calculate weight of raw materials. 3.8 Calculate price of raw materials. 3.9 Add overhead charges to determine the estimated production cost. 3.10 Maintain the record of performed task.</p>	1	2
4	<p>ESTIMATE THE PRODUCTION COST OF A G.I. FUNNEL</p> <p>4.1 Sketch Funnel. 4.2 Measure the dimension of a Funnel. 4.3 Identify the parts of a Funnel. 4.4 Develop the surfaces of the parts. 4.5 Prepare Layout on raw materials by sketch. 4.6 Add necessary allowances. 4.7 Calculate weight of raw materials 4.8 Calculate price of raw materials 4.9 Add overhead charges to determine estimated production cost. 4.10 Maintain the record of performed task.</p>	2	3
5	<p>ESTIMATE THE PRODUCTION COST OF A G.I. BUCKET</p> <p>5.1 Sketch Bucket. 5.2 Measure the dimension of a Bucket. 5.3 Identify the simple parts of a Bucket. 5.4 Develop the surfaces of the parts 5.5 Prepare Layout on raw materials by sketch. 5.6 Add necessary allowances 5.7 Calculate weight of raw materials</p>	2	3

	<p>5.8 Calculate price of raw materials</p> <p>5.9 Add overhead charges to determine estimated production cost.</p> <p>5.10 Maintain the record of performed task.</p>		
6	<p>ESTIMATE THE PRODUCTION COST OF A M.S. CENTER PUNCH</p> <p>6.1 Sketch center punch with the dimension</p> <p>6.2 Divide the figure into simple geometric parts</p> <p>6.3 Calculate the volume of Center Punch.</p> <p>6.4 Add allowances and calculate total volume</p> <p>6.5 Calculate weight</p> <p>6.6 Calculate price of raw material</p> <p>6.7 Calculate total machining time</p> <p>6.8 Calculate labor cost</p> <p>6.9 Calculate overhead charges</p> <p>6.10 Maintain the record of performed task.</p>	1	2
7	<p>ESTIMATE THE PRODUCTION COST OF A MS BALL PEEN HAMMER</p> <p>7.1 Sketch Ball Peen Hammer with dimension.</p> <p>7.2 Draw the figure separately of the deferent parts.</p> <p>7.3 Put the dimension of the figure.</p> <p>7.4 Calculate volume of each part.</p> <p>7.5 Add allowances Calculate total volume.</p> <p>7.6 Calculate weight.</p> <p>7.7 Calculate price of raw material.</p> <p>7.8 Calculate total machining time.</p> <p>7.1 Calculate labor cost.</p> <p>7.10 Calculate overhead charges.</p> <p>7.11 Maintain the record of performed task.</p>	2	3
8	<p>ESTIMATE THE PRODUCTION COST OF A GI TRAY</p> <p>8.1 Sketch the figure of a Tray according to dimension.</p> <p>8.2 Put the layout on the Raw materials.</p> <p>8.3 Calculate the amount of GI sheet.</p> <p>8.4 Add allowances of GI sheet.</p> <p>8.5 Calculate total amount of GI sheet.</p> <p>8.6 Calculate pattern and labor cost</p> <p>8.7 Calculate overhead charges</p> <p>8.8 Determine estimated production cost.</p> <p>8.9 Maintain the record of performed task.</p>	1	2
9	<p>ESTIMATE THE PRODUCTION COST OF A V- BLOCK</p>	2	3

	<p>9.1 Sketch the figure of a V-block according to dimension.</p> <p>9.2 Put the layout on the Raw materials.</p> <p>9.3 Calculate the amount of MS square bar.</p> <p>9.4 Calculate weight of MS square bar.</p> <p>9.5 Add allowances of MS square bar.</p> <p>9.6 Calculate the total weight of MS square bar.</p> <p>9.7 Calculate labor cost V-Block.</p> <p>9.8 Calculate overhead cost to production of V-Block.</p> <p>9.9 Calculate the total estimated production cost of V-Block</p> <p>9.10 Maintain the record of performed task.</p>		
10	<p>ESTIMATE THE PRODUCTION COST OF A CAST IRON (CI) BRACKET</p> <p>10.1 Sketch the figure of a bracket according to dimension.</p> <p>10.2 Put the layout on the Raw materials.</p> <p>10.3 Calculate the amount of Raw materials for CI bracket.</p> <p>10.4 Calculate the weight of CI bracket.</p> <p>10.5 Calculate the total weight of CI bracket.</p> <p>10.6 Calculate the labor cost to production of CI bracket</p> <p>10.7 Calculate overhead charges to production of CI bracket</p> <p>10.8 Calculate the total estimated production cost to production of CI bracket.</p> <p>10.9 Maintain the record of performed task.</p>	2	2
Total		16	25

NECESSARY RESOURCES (TOOLS, EQUIPMENT'S AND MACHINERY):

SL No.	Item Name	Quantity
01	Bar folding machine	3 Nos.
02	Sheet bending machine	3 Nos.
03	Hand shear Machine	3 Nos.
04	Wooden hammer	25 Nos.
05	Ball pin hammer	25 Nos.
06	Steel rule, Scriber, Tri-square, Measure tape, Snip, Center punch, Die and punch	Each 25 Nos.
07	Hand glove	25 pair
08	Table vice, Working table	Each 10 Nos.
09	Punch block	25 Nos.
10	Digital weight balance (Lab use 0.001-1000gm) Flat type	05Nos

RECOMMENDED BOOKS:

SL No.	Book Name	Writer Name	Publisher Name & Edition
01	Mechanical Estimating and costing	T.R BANGA & S.C. SHARMA	Khanna Publisher -16 th Edition.
02	Mechanical Estimating and costing	O.P. Khanna	Dhanpat rai & sons 2 nd Edition
03	Mechanical Estimating and costing	B. P. Shinha	Khanna Publisher
04	Mechanical Estimating	TTTC	TTTC

WEBSITE REFERENCES:

SL No.	Web Link	Remarks
01	www.youtube.com	Search here with topics
02	www.google.com	Search here with topics

Board may rearrange marks distribution for question setting (If necessary)

SUBJECT CODE	SUBJECT NAME	PERIOD PER WEEK		CREDIT
27053	Advanced Welding -1	T	P	C
		2	6	4

Rationale	<p>The term welding is used to cover a wide range of bonding techniques. Now a day's many processes of welding have been developed and probably there is no industry which is not using welding processes in fabrication of products in some form or the others. This is most rapid and easiest way to fabrication and assembly of metal parts. One beauty of welding is comparison to other processes of joining metals is that by this process we can have more than 100% strength of joint and it is very easy process. Welding is now a day extensively used in the following fields: automobile industry, structural works, boiler making, tank making, machine repair, ship frames, pipe line fabrication etc. Gas cutting is another field of application of welding process which is playing very important role in industry.</p> <p>We will be dealing with common processes of welding in use these days. Such as arc welding, gas welding, thermit welding, soldering, brazing etc. The equipment's used for each processes and the way of preparation of joint and various operation is necessary.</p>
Learning Outcome (Theoretical)	<p>After undergoing the subject, students will be able to</p> <ol style="list-style-type: none"> 1. State the principle of Arc, Gas, Resistance and Thermit welding. 2. Describe the processes of Arc, Gas, Resistance and Thermit welding. 3. Describe the processes of Soldering and Brazing. 4. State the equipment's of welding. 5. Explain the different position of welding. 6. State diagnoses polarity of Arc welding. 7. Compare different types of welding. 8. Interpret defects of welding. 9. Prepare test report on welding.
Learning Outcome (Practical)	<p>After undergoing the subject, students will be able to</p> <ol style="list-style-type: none"> 1. Practice OHS. 2. Select electrode for Arc welding. 3. Set current and voltage for Arc welding. 4. Select polarity for Arc welding. 5. Demonstrate different types of joints. 6. Operate welding machine. 7. Perform Arc welding. 8. Perform Gas welding. 9. Perform Spot welding. 10. Perform Thermit welding. 11. Perform Brazing and Soldering. 12. Identify defects, causes and remedies of welding. 13. Perform welding test.

DETAILED SYLLABUS (THEORY)

Unit	Topics with Contents	Class (1 Period)	Final Marks
1	Introduction to welding 1.1 Define welding. 1.2 Classify welding processes. 1.3 Discuss the advantages and disadvantages of welding processes. 1.4 Describe weld ability of metals. 1.5 Explain the metallurgical change in welding. 1.6 Describe different types of welding joint. 1.7 Explain welding methods. 1.8 Describe the different positions of welding. 1.9 Describe occupational health and safety (OHS) for welding shop.	02	06
2	Arc welding process 2.1 Define Arc welding. 2.2 Explain different types of Arc welding. 2.3 Describe the principles of Arc welding process. 2.4 Explain the effects of striking voltage, arc voltage and open circuit voltage. 2.5 Explain the voltage and current regulation of the Arc welding set. 2.6 Describe electrode with specification. 2.7 Describe the ingredients used in coating on electrode. 2.8 Describe the selection procedure of electrode. 2.9 Explain different types of Polarity. 2.10 Describe electric Arc welding process.	04	07
3	Gas welding 3.1 State Gas welding. 3.2 State different types of Gas welding flame. 3.3 State the procedure to apply natural gas in Gas welding process. 3.4 Compares among oxygen-acetylene and liquefied-petroleum gas (LPG) cylinder. 3.5 Explain the uses of flux in gas welding. 3.6 Mention the uses of filler rod of gas welding. 3.7 Describe the oxy-acetylene and oxy-LPG welding process. 3.8 Describe back fire and flash back. 3.9 Describe pre-heat and gas economizer. 3.10 Mention safety precautions of gas welding.	04	07
4	Equipment's of gas welding 4.1 State the principles of gas regulators. 4.2 Describe different types of regulators. 4.3 Describe oxygen, acetylene and natural gas cylinder. 4.4 Explain the operating principles of welding torches.	03	06

	<p>4.5 Describe the uses of different types of welding torches.</p> <p>4.6 Interpret different types of torch tips.</p> <p>4.7 Describe selection procedure of torch tips.</p> <p>4.8 Mention the uses of oxy-acetylene and oxy-LPG welding.</p> <p>4.9 Mention safety rules for equipment of gas welding.</p>		
5	<p>Soldering and Brazing</p> <p>5.1 Define Soldering and Brazing.</p> <p>5.2 Compare between Soldering and Brazing.</p> <p>5.3 Describe composition of Solders.</p> <p>5.4 Mention filler metals used in Soldering and Brazing.</p> <p>5.5 Describe essential steps in Soldering operation.</p> <p>5.6 Describe essential steps in Brazing operation.</p> <p>5.7 Explain different types of flux used in Soldering and Brazing.</p>	02	04
6	<p>Gas cutting</p> <p>6.1 Describe the construction of gas cutting torch.</p> <p>6.2 Describe the selection criteria of gas cutting torch tip.</p> <p>6.3 Distinguish between a gas welding torch and a gas cutting torch.</p> <p>6.4 Describe flame machining and gouging.</p> <p>6.5 Compare the advantages and disadvantages of gas cutting and arc cutting.</p> <p>6.6 Describe gas cutting processes.</p> <p>6.7 Mention the safety precautions in gas cutting.</p>	04	06
7	<p>Resistance welding</p> <p>7.1 Describe the principles of Resistance welding.</p> <p>7.2 Describe the construction and operation of resistance welding machine.</p> <p>7.3 Classify resistance welding.</p> <p>7.3 Describe the different types of resistance welding processes.</p> <p>7.4 List the advantages and limitations of resistance welding process.</p> <p>7.5 Distinguish between resistances welding with other welding processes.</p> <p>7.6 Mention safety precautions of resistance welding.</p>	03	05
8	<p>Groove (G) & Fillet (F) welding</p> <p>8.1 Describe the G position of arc welding technique</p> <p>8.2 Describe the F-position of arc welding technique.</p> <p>8.3 Describe 1F & 2F position for plate welding.</p> <p>8.4 Explain 3F & 4F position for plate welding.</p> <p>8.5 Describe 1G & 2G position for plate and pipe welding.</p> <p>8.6 Describe 3G & 4G position for plate welding.</p> <p>8.7 Explain 5G & 6G position for pipe welding.</p> <p>8.8 Describe 6GR (Resected) position for pipe welding.</p> <p>8.9 Mention care and safety needed for various G&F-position plate and pipe welding.</p>	03	07
9	<p>Thermit welding</p>	02	04

	<p>9.1 State the principle of thermit welding.</p> <p>9.2 Mention applications of thermit welding.</p> <p>9.3 Point out the advantages and limitations of thermit welding.</p> <p>9.4 Describe thermit welding processes.</p>		
10	<p>Welding Defects</p> <p>10.1 Describe welding defects.</p> <p>10.2 Mention different types of welding defect.</p> <p>10.3 List the defects of welding.</p> <p>10.4 State the causes of defects in welding.</p> <p>10.5 Describe the remedies of defects in welding.</p> <p>10.6 Describe the inspection methods of detecting welding defects.</p>	03	06
11	<p>Testing of welding joints</p> <p>11.1 Explain the necessity of testing the welds.</p> <p>11.2 Describe the non-destructive tests of detecting welding defects.</p> <p>11.3 Describe the destructive tests of welding.</p> <p>11.4 State the significance of testing welding joint.</p>	02	02
	Total	32	60

DETAILED SYLLABUS (PRACTICAL)

Sl.	Experiment Name with procedure	Class (3 Period)	Marks (Continuous)
1	<p>PERFORM SETTING OF ARC WELDING MACHINE.</p> <p>1.1 Follow occupational health and safety (OHS).</p> <p>1.2 Collect tools, equipment and accessories.</p> <p>1.3 Set current and voltage according to the job requirements.</p> <p>1.4 Select and set electrode with electrode holder.</p> <p>1.5 Maintain the record of performed task.</p>	1	2
2	<p>PERFORM THE STRAIGHT WELD BEAD WELDING ON MS FLAT BAR IN FLAT POSITION BY ELECTRIC ARC WELDING.</p> <p>2.1 Follow occupational health and safety (OHS).</p> <p>2.2 Collect tools, equipment and accessories.</p> <p>2.3 Prepare drawing.</p> <p>2.4 Select materials.</p> <p>2.5 Select and hold electrode.</p> <p>2.6 Set the voltage and current according to metal.</p> <p>2.7 Cut MS flat bar according specification.</p> <p>2.8 Select and practice PPE.</p> <p>2.9 Perform straight weld bead by electric arc welding m/c.</p> <p>2.10 Off the connection of arc welding machine.</p> <p>2.11 Clean the job and work place.</p> <p>2.12 Maintain the record of performed task.</p>	2	3

3	<p>PERFORM LAP JOINT ON MS FLAT BAR IN FLAT POSITION (1F) BY ELECTRIC ARC WELDING.</p> <p>3.1 Follow occupational health and safety (OHS). 3.2 Collect tools, equipment and accessories. 3.3 Prepare drawing. 3.4 Select materials. 3.5 Select and hold electrode. 3.6 Set the voltage and current according to metal. 3.7 Cut MS flat bar according drawing. 3.8 Select and practice PPE. 3.9 Perform lap joint on MS flat bar in flat position by electric arc welding m/c. 3.10 Off the connection of arc welding machine. 3.11 Clean the job and work place. 3.12 Maintain the record of performed task.</p>	2	3
4	<p>PERFORM SINGLE BUTT JOINT ON MS FLAT BAR IN FLAT POSITION BY ELECTRIC ARC WELDING.</p> <p>4.1 Follow occupational health and safety (OHS). 4.2 Collect tools, equipment and accessories. 4.3 Prepare drawing. 4.4 Select materials. 4.5 Select and hold electrode. 4.6 Set the voltage and current according to metal. 4.7 Cut MS flat bar according drawing. 4.8 Select and practice PPE. 4.9 Perform single butt joint on MS flat bar in flat position by electric arc welding m/c. 4.10 Off the connection of arc welding machine. 4.11 Clean the job and work place. 4.12 Maintain the record of performed task.</p>	2	3
5	<p>PERFORM T JOINT ON MS FLAT BAR IN HORIZONTAL POSITION (2F) BY ELECTRIC ARC WELDING.</p> <p>5.1 Follow occupational health and safety (OHS). 5.2 Collect tools, equipment and accessories. 5.3 Prepare drawing. 5.4 Select materials. 5.5 Select and hold electrode. 5.6 Set the voltage and current according to metal. 5.7 Cut MS flat bar according drawing. 5.8 Select and practice PPE. 5.9 Perform T joint on MS flat bar in horizontal position by electric arc welding m/c. 5.10 Off the connection of arc welding machine. 5.11 Clean the job and work place. 5.12 Maintain the record of performed task.</p>	2	3

6	<p>PERFORM STRAIGHT BEAD ON MS SHEET BY GAS WELDING.</p> <p>6.1 Follow occupational health and safety (OHS). 6.2 Collect tools, equipment and accessories. 6.3 Prepare drawing. 6.4 Select and cut metal according to drawing and clean metal. 6.5 Select gas welding tools, filler metal, flux and accessories. 6.6 Select and adjust oxygen and acetylene pressure regulator of cylinder. 6.7 Select and practice PPE. 6.8 Make gas flame by adjusting oxygen and acetylene knob of welding torch. 6.9 Perform straight bead according to drawing. 6.10 Stop the gas flow. 6.11 Clean the job and work place. 6.12 Maintain the record of performed task.</p>	2	3
7	<p>PERFORM LAP JOINT ON MS SHEET IN FLAT POSITION BY GAS WELDING.</p> <p>7.1 Follow occupational health and safety (OHS). 7.2 Collect tools, equipment and accessories. 7.3 Prepare drawing. 7.4 Select and cut metal according to drawing and clean metal. 7.5 Select gas welding tools, filler metal, flux and accessories. 7.6 Select and adjust oxygen and acetylene pressure regulator of cylinder. 7.7 Select and practice PPE. 7.8 Make gas flame by adjusting oxygen and acetylene knob of welding torch. 7.9 Perform lap joint on MS sheet in flat position according to drawing. 7.10 Stop the gas flow. 7.11 Clean the job and work place. 7.12 Maintain the record of performed task.</p>	1	3
8	<p>PERFORM BUTT JOINT ON MS SHEET IN HORIZONTAL POSITION BY GAS WELDING.</p> <p>8.1 Follow occupational health and safety (OHS). 8.2 Collect tools, equipment and accessories. 8.3 Prepare drawing. 8.4 Select and cut metal according to drawing and clean metal. 8.5 Select gas welding tools, filler metal, flux and accessories. 8.6 Select and adjust oxygen and acetylene pressure regulator of cylinder.</p>	1	3

	<p>8.7 Select and practice PPE.</p> <p>8.8 Make gas flame by adjusting oxygen and acetylene knob of welding torch.</p> <p>8.9 Perform but joint on MS sheet in horizontal position according to drawing.</p> <p>8.10 Stop the gas flow.</p> <p>8.11 Clean the job and work place.</p> <p>8.12 Maintain the record of performed task.</p>		
9	<p>PERFORM STRAIGHT GAS CUTTING ON MS PLATE.</p> <p>9.1 Follow occupational health and safety (OHS).</p> <p>9.2 Collect tools, equipment and accessories.</p> <p>9.3 Prepare drawing.</p> <p>9.4 Select metal to be cut.</p> <p>9.5 Select gas cutting torch.</p> <p>9.6 Select and adjust oxygen and acetylene pressure regulator of cylinder.</p> <p>9.7 Select and practice PPE.</p> <p>9.8 Make gas flame by adjusting oxygen and acetylene knob of cutting torch.</p> <p>9.9 Perform straight gas cutting on MS plate.</p> <p>9.10 Stop the gas flow.</p> <p>9.11 Clean the job and work place.</p> <p>9.12 Maintain the record of performed task.</p>	2	3
10	<p>PERFORM BRAZING ON STEEL PIPES.</p> <p>10.1 Follow occupational health and safety (OHS).</p> <p>10.2 Collect tools, equipment and accessories.</p> <p>10.3 Prepare drawing.</p> <p>10.4 Select and cut metal according to drawing and clean metal.</p> <p>10.5 Select gas welding tools, filler metal, flux and accessories.</p> <p>10.6 Select and adjust oxygen and acetylene pressure regulator of cylinder.</p> <p>10.7 Select and practice PPE.</p> <p>10.8 Make gas flame by adjusting oxygen and acetylene knob of welding torch.</p> <p>10.9 Perform brazing on steel pipe according to drawing.</p> <p>10.10 Stop the gas flow.</p> <p>10.11 Clean the job and work place.</p> <p>10.12 Maintain the record of performed task.</p>	1	3
11	<p>MAKE A SQUARE WIRE MESH BY SPOT WELDING.</p> <p>11.1 Follow operational health and safety (OHS).</p> <p>11.2 Collect tools, equipment and accessories.</p> <p>11.3 Prepare drawing.</p> <p>11.4 Select materials.</p> <p>11.5 Select and hold electrode.</p> <p>11.6 Set the voltage and current according to metal.</p> <p>11.7 Cut wire according drawing.</p>	1	3

	<p>11.8 Select and practice PPE.</p> <p>11.9 Perform a square wire mesh by spot welding m/c.</p> <p>11.10 Clean the job and workplace.</p> <p>11.11 Maintain the record of performed task.</p>			
12	<p>PERFORM FILLET JOINTS ON MS FLAT BAR IN VERTICAL (3F) POSITION.</p> <p>12.1 Follow occupational health and safety (OHS).</p> <p>12.2 Collect tools, equipment and accessories.</p> <p>12.3 Prepare drawing.</p> <p>12.4 Select materials.</p> <p>12.5 Select and hold electrode.</p> <p>12.6 Set the voltage and current according to metal.</p> <p>12.7 Cut MS flat bar according drawing.</p> <p>12.8 Select and practice PPE.</p> <p>12.9 Perform fillet joint on MS flat bar in vertical (3F) position by electric arc welding m/c.</p> <p>12.10 Clean the job and workplace.</p> <p>12.11 Maintain the record of performed task.</p>	2	2	3
13	<p>PERFORM FILLET JOINTS ON MS FLAT BAR IN OVERHEAD (4F) POSITION.</p> <p>13.1 Follow occupational health and safety (OHS).</p> <p>13.2 Collect tools, equipment and accessories.</p> <p>13.3 Prepare drawing.</p> <p>13.4 Select materials.</p> <p>13.5 Select and hold electrode.</p> <p>13.6 Set the voltage and current according to metal.</p> <p>13.7 Cut MS flat bar according drawing.</p> <p>13.8 Select and practice PPE.</p> <p>13.9 Perform fillet joint on MS flat bar in overhead (4F) position by electric arc welding m/c.</p> <p>13.10 Clean the job and workplace.</p> <p>13.11 Maintain the record of performed task.</p>	2	2	
14	<p>PERFORM V-BUTT JOINTS ON MS FLAT BAR BY FLAT POSITION (1G) POSITION.</p> <p>14.1 Follow occupational health and safety (OHS).</p> <p>14.2 Collect tools, equipment and accessories.</p> <p>14.3 Prepare drawing.</p> <p>14.4 Select materials.</p> <p>14.5 Select and hold electrode.</p> <p>14.6 Set the voltage and current according to metal.</p> <p>14.7 Cut MS flat bar according drawing.</p> <p>14.8 Select and practice PPE.</p> <p>14.9 Perform V-butt joint on MS flat bar in flat position (1G) position by electric arc welding m/c.</p> <p>14.10 Clean the job and workplace.</p> <p>14.11 Maintain the record of performed task.</p>	2	2	

15	<p>PERFORM V-BUTT JOINTS ON MS PLATE BY HORIZONTAL (2G) POSITION.</p> <p>15.1 Follow occupational health and safety (OHS). 15.2 Collect tools, equipment and accessories. 15.3 Prepare drawing. 15.4 Select materials. 15.5 Select and hold electrode. 15.6 Set the voltage and current according to metal. 15.7 Cut MS flat bar according drawing. 15.8 Select and practice PPE. 15.9 Perform V-butt joint on MS plate by horizontal (2G) position by electric arc welding m/c. 15.10 Clean the job and work place. 15.11 Maintain the record of performed task.</p>	2	2	
16	<p>PERFORM V-BUTT JOINTS ON MS FLAT BAR BY VERTICAL (3G) POSITION.</p> <p>16.1 Follow occupational health and safety (OHS). 16.2 Collect tools, equipment and accessories. 16.3 Prepare drawing. 16.4 Select materials. 16.5 Select and hold electrode. 16.6 Set the voltage and current according to metal. 16.7 Cut MS flat bar according drawing. 16.8 Select and practice PPE. 16.9 Perform V-butt joint on MS flat bar by vertical (3G) position by electric arc welding m/c. 16.10 Clean the job and work place. 16.11 Maintain the record of performed task.</p>	2	2	
17	<p>PERFORM V-BUTT JOINTS ON MS FLAT BAR BY OVERHEAD (4G) POSITION.</p> <p>17.1 Follow occupational health and safety (OHS). 17.2 Collect tools, equipment and accessories. 17.3 Prepare drawing. 17.4 Select materials. 17.5 Select and hold electrode. 17.6 Set the voltage and current according to metal. 17.7 Cut MS flat bar according drawing. 17.8 Select and practice PPE. 17.9 Perform V-butt joint on MS flat bar by overhead (4G) position by electric arc welding m/c. 17.10 Clean the job and work place. 17.11 Maintain the record of performed task.</p>	2	2	3
18	<p>PERFORM V-BUTT JOINTS ON PIPE BY 5G POSITION.</p> <p>18.1 Follow occupational health and safety (OHS). 18.2 Collect tools, equipment and accessories. 18.3 Prepare drawing. 18.4 Select materials. 18.5 Select and hold electrode.</p>	1	2	

	18.6 Set the voltage and current according to metal. 18.7 Cut MS pipe according drawing. 18.8 Select and practice PPE. 18.9 Perform 5G welding on pipe by electric arc welding m/c. 18.10 Clean the job and work place. 18.11 Maintain the record of performed task.			
19	PERFORM V-BUTT JOINTS ON PIPE BY 6G POSITION. 19.1 Follow occupational health and safety (OHS). 19.2 Collect tools, equipment and accessories. 19.3 Prepare drawing. 19.4 Select materials. 19.5 Select and hold electrode. 19.6 Set the voltage and current according to metal. 19.7 Cut MS pipe according drawing. 19.8 Select and practice PPE. 19.9 Perform 6G welding on pipe by electric arc welding m/c. 19.10 Clean the job and work place. 19.11 Maintain the record of performed task.	1	2	
20	PERFORM JOINING OF BROKEN SHAFT BY THERMITE WELDING. 20.1 Follow occupational health and safety (OHS). 20.2 Collect tools, equipment and accessories. 20.3 Set the weld gap. 20.4 Apply clamp and fix the mould 20.5 Leave the thermit mixture into the crucible. 20.6 Preheat the end of the rail. 20.7 Ignite and let steel flow. 20.8 Remove the mould and excess head metal. 20.9 Grinding the joint. 20.10 Clean the job and work place. 20.11 Maintain the record of performed task.	1	2	
Total		32	50	

NECESSARY RESOURCES (TOOLS, EQUIPMENT'S AND MACHINERY):

SI	Item Name	Quantity
01	Arc welding machine	5 nos
02	Oxygen cylinder	5 nos
03	Acetylene cylinder	5 nos
04	Spot welding machine	2 nos
05	Gas pressure regulator	10 nos
06	Electrode holder	5 nos
07	Welding cable	5 nos
08	Earth clamp	5 nos

09	Gas welding torch	10 nos
10	Gas cutting torch	10 nos
11	Thermit welding equipment's	8 nos
12	Spark lighter	10 nos
13	Welding helmet	20 nos
14	Hand shield	20 nos
15	Hand Gloves	30 pair
16	Apron	25 nos
17	Safety shoes	25 pair

RECOMMENDED BOOKS:

SI	Book Name	Writer Name	Publisher Name & Edition
01	Welding processes Hand book	Klas Weman	Woodhead Publication Ltd.(2006)
02	Advanced Welding processes	John Norrish.	Woodhead Publication Ltd. (2006)
03	Advanced Joining Technology	T.H.North.	Springer international publishing (October,5,2011)
04	Production Technology	R.K Jain	Khanna Publishers
05	Advanced Manufacturing Technologies	Kapil Gupta.	Springer international publishing (April,29,2017)
06	Advanced Welding Technology	Ashutosh, Som	Excel Books (1, Dec, 2010)

WEBSITE REFERENCES:

SI	Web Link	Remarks
01	www.youtube.com	Search here with topics
02	www.google.com	Search here with topics

Board may rearrange marks distribution for question setting (If necessary)

SUBJECT CODE	SUBJECT NAME	PERIOD PER WEEK		CREDIT
		T	P	
27054	FOUNDRY & PATTERN MAKING	2	3	3

Rationale	<p>Foundry and pattern making are two essential processes in the manufacturing industry. Foundries produce metal castings by pouring molten metal into a mould. Pattern making is the process of creating the mould, which is typically made of wood, metal, or plastic. Foundry and pattern making are important for a number of reasons. First, they allow the production of complex shapes that would be difficult or impossible to produce using other methods. Second, they allow to the production parts that are very strong and durable. Third, they are relatively cost-effective especially for mass production.</p> <p>Foundry and pattern making are used in a wide variety of industries, including automotive, aerospace, construction, and machinery. Basically, foundry and pattern making is a field that deals with making different types of pattern, mould, core, operation and maintenance of different furnaces, different casting methods and their defects, modern automation and their application in industries and the environmental impact relating this field. Some specific benefits of foundry and pattern making are versatility, strength and durability, cost-effectiveness, etc. In addition to these benefits foundry and pattern making also play an important role in innovation. Overall, foundry and pattern making are essential processes for the production of a wide variety of products that we rely on every day.</p>
Learning Outcome (Theoretical)	<p>After undergoing the subject, students will be able to</p> <ol style="list-style-type: none"> 1. Explain foundry engineering. 2. State safety protocols of foundry work. 3. Distinguish different types of material for pattern making, mould making, core making and casting. 4. Explain properties of moulding and core making sand. 5. Explain different types of pattern and pattern allowances. 6. Explain different types of mould. 7. Explain different types of core. 8. Explain different types of furnace. 9. Interpret casting and casting defects. 10. Explain casting procedures. 11. Explain die casting. 12. Interpret foundry automation. 13. State the application of foundry automation in industry. 14. Explain environmental impacts of foundry work.
Learning Outcome (Practical)	<p>After undergoing the subject, students will be able to</p> <ol style="list-style-type: none"> 1. Prepare moulding sand with proper ratio. 2. Perform permeability test of moulding sand. 3. Perform moisture content test of moulding sand. 4. Perform grain size fineness test of moulding sand. 5. Prepare core making sand with proper ratio. 6. Make sand mould using different types of pattern. 7. Make core for hollow job. 8. Make pattern ensuring appropriate allowances. 9. Prepare and charge furnace for casting. 10. Perform casting. 11. Detect casting defects.

DETAILED SYLLABUS (THEORY)

Unit	Topics with Contents	Class (1 Period)	Final Marks
1.	FOUNDRY ENGINEERING AND RELATING SAFETY RULES 1.1 Define foundry engineering. 1.2 State evolution of foundry engineering. 1.3 State the importance of foundry engineering in modern manufacturing system. 1.4 List the different sections of foundry engineering. 1.5 Define pattern making, mould and core making, metal melting and casting section. 1.6 State general safety rules for foundry engineering. 1.7 Mention personal protective equipment (PPE) for foundry Work. 1.8 Explain environmental impacts of foundry engineering.	02	03
2	MATERIALS IN FOUNDRY ENGINEERING 2.1 State the materials used in pattern making. 2.2 Describe materials used in mould and core making. 2.3 Mention different types of moulding sand. 2.4 Describe composition of moulding and core making sand. 2.5 Describe materials used in producing product by casting. 2.6 List different metals and alloys used in casting. 2.7 Mention the properties of metals and alloys used in casting.	04	06
3	PATTERNS AND PATTERN ALLOWANCES 3.1 Describe different types of pattern. 3.2 List the color code of patterns. 3.3 Describe different process of pattern making. 3.4 Mention different tools, equipment and machineries in pattern making. 3.5 Describe different types of pattern allowances . 3.6 Mention the application of different types of pattern allowances	04	09
4	MOULD MAKING PROCESS 4.1 Describe moulding processes 4.2 Mention different tools, equipment and machineries in mould making. 4.3 Mention the advantages and disadvantages of different moulding machines. 4.4 State properties of moulding sand. 4.5 Describe different sand testing processes for mould making. 4.6 Describe different defects of mould.	05	09
5	CORE MAKING PROCESS 5.1 Explain Core. 5.2 Describe different types of cores. 5.3 State the characteristics of core sand. 5.4 Describe the procedures of core making. 5.5 Explain the processes of core drying. 5.6 State different types of core sand.	02	03

	5.7 Explain the testing of core sand. 5.8 Describe different defects of core.		
6	MELTING AND RE-MELTING FURNACES 6.1 State melting and re-melting furnaces. 6.2 Distinguish between melting and re-melting furnaces. 6.3 Describe Blast furnace. 6.4 State the operation processes of Blast furnace. 6.5 Describe Cupola, Pit, Crucible, Tilting, Induction and Electric Arc Furnace with operation processes. 6.6 Mention different types of charging materials with appropriate proportion in re-melting furnaces. 6.7 Define refractory materials. 6.8 State different types of refractory materials. 6.8 Mention the uses of re-melting furnaces.	04	09
7	CASTING 7.1 Define casting 7.2 Describe different types of casting processes. 7.3 Describe different steps of casting process. 7.4 Mention solidification and cooling processes of casting. 7.5 Explain cleaning and fettling procedures of casting. 7.6 Describe quality control of casting.	03	06
8	DIE CASTING 8.1 Define die casting. 8.2 State characteristics of die metal. 8.3 Define dies. 8.4 State design considerations in die casting. 8.5 Mention different types of die casting machine. 8.6 Describe die casting alloys with composition. 8.7 Describe advantages and limitations of die casting.	02	03
9	CASTING DEFECTS 9.1 State casting defects. 9.2 Mention different types of casting defects. 9.3 Describe reasons of different types of casting defects. 9.4 Explain remedies of different types of casting defects.	03	06
10	FOUNDRY AUTOMATION AND APPLICATION IN INDUSTRIES 10.1 Define foundry automation. 10.2 Explain benefits of foundry automation. 10.3 Mention challenges in foundry automation. 10.4 State the significance of foundry automation in fourth industrial revolution. 10.5 State the foundry automation scenario of Local Industries. 10.6 Describe the promising practices of foundry automation in Local Industry.	03	06
	Total	32	60

DETAILED SYLLABUS (PRACTICAL)

Sl.	Experiment Name	Class (3 Period)	Marks (Continuous)
1	PREPARE MOULDING SAND WITH APPROPRIATE RATIO OF INGREDIENTS. 1.1 Follow the safety rules. 1.2 Wear PPE. 1.3 Collect appropriate tools for mixing sand. 1.4 Collect required ingredients for mixing with sand. 1.5 Mix sand with other ingredients properly. 1.6 Examine the prepared moulding sand with proper inspection. 1.7 Clean and re-store the tools accordingly. 1.8 Maintain the record of performed task.	2	2
2	MAKE A MOULD WITH A SINGLE PIECE PATTERN. 2.1 Follow the safety rules. 2.2 Wear PPE. 2.3 Collect appropriate tools and equipment for making mould. 2.4 Prepare moulding sand properly. 2.5 Collect a single piece pattern. 2.6 Set the pattern in the moulding box. 2.7 Perform ramming and arrange other necessities (Runner, Riser, Sprue, Gate, etc.) for making a mould. 2.8 Complete the mould properly. 2.9 Clean and re-store the tools accordingly. 2.10 Maintain the record of performed task.	2	3
3	MAKE A MOULD WITH A SPLIT PATTERN. 3.1 Follow the safety rules. 3.2 Wear PPE. 3.3 Collect appropriate tools and equipment for making mould. 3.4 Prepare moulding sand properly. 3.5 Collect a split pattern. 3.6 Set the pattern in the moulding box. 3.7 Perform ramming and arrange other necessities (Runner, Riser, Sprue, Gate, etc.) for making a mould. 3.8 Complete the mould properly. 3.9 Clean and re-store the tools accordingly. 3.10 Maintain the record of performed task.	2	3
4	MAKE A MOULD WITH SWIPE PATTERN. 4.1 Follow the safety rules. 4.2 Wear PPE. 4.3 Collect appropriate tools and equipment for making mould. 4.4 Prepare moulding sand properly. 4.5 Collect a swipe pattern. 4.6 Set the pattern in the moulding box. 4.7 Perform ramming and arrange other necessities (Runner, Riser, Sprue, Gate, etc.) for making a mould. 4.8 Complete the mould properly. 4.9 Clean and re-store the tools accordingly. 4.10 Maintain the record of performed task.	2	3
5	MAKE A WOODEN SINGLE PIECE PATTERN.	2	2

	<p>5.1 Follow the safety rules.</p> <p>5.2 Wear PPE.</p> <p>5.3 Collect appropriate tools and equipment.</p> <p>5.4 Collect appropriate wood.</p> <p>5.5 Perform required machining and finishing operations ensuring appropriate allowances.</p> <p>5.6 Clean and re-store the tools accordingly.</p> <p>5.7 Maintain the record of performed task.</p>		
6	<p>MAKE A CORE FOR A HOLLOW JOB.</p> <p>6 Follow the safety rules.</p> <p>6.2 Wear PPE.</p> <p>6.3 Collect appropriate tools and equipment.</p> <p>6.4 Prepare core making sand with appropriate ratio of ingredients.</p> <p>6.5 Prepare the core.</p> <p>6.6 Dry the core in oven.</p> <p>6.7 Clean and re-store the tools accordingly.</p> <p>6.8 Maintain the record of performed task.</p>	2	2
7	<p>PERFORM PERMEABILITY TEST OF MOULDING SAND.</p> <p>7.1 Follow the safety rules.</p> <p>7.2 Wear PPE.</p> <p>7.3 Collect appropriate tools, equipment and permeability testing machine.</p> <p>7.4 Perform the test.</p> <p>7.5 Calculate and find the result.</p> <p>7.6 Clean and re-store the tools, equipment and permeability testing machine accordingly.</p> <p>7.7 Maintain the record of performed task.</p>	1	2
8	<p>PERFORM MOISTURE CONTENT TEST OF MOULDING SAND.</p> <p>8.1 Follow the safety rules.</p> <p>8.2 Wear PPE.</p> <p>8.3 Collect appropriate tools, equipment and moisture content testing apparatus.</p> <p>8.4 Perform the test.</p> <p>8.5 Calculate and find the result.</p> <p>8.6 Clean and re-store the tools, equipment and moisture content testing apparatus accordingly.</p> <p>8.7 Maintain the record of performed task.</p>	1	2
9	<p>PERFORM GRAIN SIZE FINENESS TEST OF MOULDING SAND.</p> <p>9.1 Follow the safety rules.</p> <p>9.2 Wear PPE.</p> <p>9.3 Collect appropriate tools, equipment and grain size fineness testing apparatus.</p> <p>9.4 Perform the test.</p> <p>9.5 Calculate and find the result.</p> <p>9.6 Clean and re-store the tools, equipment and grain size fineness testing apparatus accordingly.</p> <p>9.7 Maintain the record of performed task.</p>	1	2
10	<p>PERFORM CASTING.</p> <p>10.1 Collect appropriate tools and equipment.</p> <p>10.2 Make a mould and core (if necessary).</p> <p>10.3 Dry the mould and core (if necessary).</p> <p>10.4 Prepare furnace.</p>	3	4

10.5 Charge the required raw materials with appropriate proportion into the furnace. 10.6 Fire the furnace. 10.7 Melt the metals into furnace. 10.8 Inspect the temperature of molten metal. 10.9 Pour the molten metal into the mould carefully. 10.10 Break the mould and collect the job after solidification. 10.11 Clean and fettle the casted job accordingly. 10.12 Detect casting defects. 10.13 Observe the promising practices of foundry automation in local industry. 10.14 Prepare and present a report regarding observation.		
Total	16	25

NECESSARY RESOURCES (TOOLS, EQUIPMENT'S AND MACHINERY):

Sl	Item Name	Quantity
01	Tools and equipment for moulding	As Necessary
02	Tools and equipment for making pattern	As Necessary
03	Tools and equipment for making core	As Necessary
04	Sand mixer machine	As Necessary
05	Crucible furnace	1
06	Induction furnace	1
07	Pit furnace	1
08	Mould drying equipment	As Necessary
09	Core drying oven	2
10	Pyrometer	2
11	Tools and equipment for casting	As Necessary
12	Permeability testing machine	4
13	Moisture content testing apparatus.	4
14	Grain size fineness testing apparatus.	4

RECOMMENDED BOOKS:

Sl	Book Name	Writer Name	Publisher Name & Edition
01	Manufacturing Technology: Foundry, Forming and Welding	P Rao	Tata McGraw Hill, 2008
02	Foundry Technology	O. P Khanna	
03	Foundry Engineering	T R Banga & R L Agarwal	
04	Production Technology	R K Jain	
05	Foundry Practice	Salmon & Simons	
06	Exploring Pattern	D Miner & John G Miller	

WEBSITE REFERENCES:

Sl	Web Link	Remarks
01	www.youtube.com	Search here with topics

02	www.google.com	Search here with topics
03	https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.iitg.ac.in/engfac/ganu/public_html/Metal%2520casting%2520processes_1.pdf&ved=2ahUKEwiZoeelo7OBAXUDS2wGHZVKBa4QFnoECAwQAQ&usg=AOvVaw3VfWn9xwsy7DZodfY8agv	Metal Casting Processes

Board may rearrange marks distribution for question setting (If necessary)

SUBJECT CODE	SUBJECT NAME	PERIOD PER WEEK		CREDIT
		T	P	
27055	MANUFACTURING PROCESS	3	0	3

Rationale	<p>Manufacturing is the process of converting a raw material into a finished, tangible product. Manufacturing entails making a process efficient as it converts specific resources by hand or by machine into a different resource for the purpose of being sold to a customer.</p> <p>Manufacturing is the Production of a Product by Processing raw materials. This is accomplished through human labor, the use of machinery and other tools in mechanical or chemical process. Manufacturing can be used on a large scale, or it can make the pieces that are assembled to build automobiles, airplanes, household appliances and more.</p> <p>Manufacturing industry are critical to a country's overall, and especially its economic development. The expansion of a country's manufacturing industries is used to gauge its economic strength.</p>
Learning Outcome (Theoretical)	<p>AFTER UNDERGOING THE SUBJECT, STUDENTS WILL BE ABLE TO</p> <ol style="list-style-type: none"> 1. Explain manufacturing processes and system. 2. Explain cold and hot working process. 3. Describe corrosion of metals. 4. Interpret electroplating. 5. Describe surface treatment processes. 6. Explain polymeric materials. 7. Illustrate plastic materials. 8. Describe glass materials. 9. Explain ceramics materials. 10. Describe Flexible manufacturing system (FMS). 11. Explain Integrated Manufacturing Systems . 12. Describe Quality Control and Inspection.

DETAILED SYLLABUS (THEORY)

Unit	Topics with Contents	Class (1 Period)	Final Marks
1.	MANUFACTURING PROCESS & SYSTEM 1.1 Define manufacturing process 1.2 Explain the concept of manufacturing process 1.3 Mention the different types of manufacturing process 1.4 Explain the manufacturing system with block diagram 1.5 Discuss the importance of reverse engineering in Bangladesh 1.6 Define concurrent engineering 1.7 Describe four phases of concurrent engineering 1.8 Describe the criteria to determine the economical product 1.9 Explain scope and benefits of manufacturing process	03	06
2	COLD WORKING PROCESS 2.1 Define cold working process 2.2 Describe different types of cold working process 2.3 Explain the controlling parameters of cold working process 2.4 Explain the effects of cold working process 2.5 Describe the advantages of cold working process 2.6 Describe the limitation of cold working process 2.7 Describe merits & demerits of plating on cold working process 2.8 List the products of cold working process	03	06
3	PROCESSES USED IN COLD WORKING 3.1 Classify cold working processes 3.2 Describe different types of squeezing 3.3 Explain different types of shearing processes 3.4 Describe different types of cold drawing processes 3.5 Explain different types of bending processes 3.6 List the machines and accessories used in cold working processes	03	05
4	HOT WORKING PROCESS 4.1 Define hot working process 4.2 Explain the controlling parameters of hot working process 4.3 Explain the effect of materials for hot working process 4.4 Mention the advantages of hot working process 4.5 Describe the limitation of hot working process 4.6 Mention merits and demerits of plating on hot working process 4.7 List the products of hot working process 4.8 List the machines and accessories in hot working processes	03	05
5	CLASSIFICATION OF HOT WORKING PROCESS	03	06

	<p>5.1 Classify hot working processes</p> <p>5.2 Describe different types of rolling processes</p> <p>5.3 Explain different types of forging processes</p> <p>5.4 Describe different types of extrusion processes</p> <p>5.5 Discuss different types of piercing processes</p> <p>5.6 State different types of cupping processes</p> <p>5.7 Explain different types of spilling processes</p>		
6	<p>CORROSION OF METALS</p> <p>6.1 Define corrosion</p> <p>6.2 Classify corrosion</p> <p>6.3 Explain the mechanism of corrosion</p> <p>6.4 Explain the controlling parameters of corrosion</p> <p>6.5 Interpret electro-chemical process of corrosion of metal, plastic and ceramic materials</p> <p>6.6 State the preventive methods of corrosion</p> <p>6.7 Describe the different types of corrosive environment</p> <p>6.8 Illustrate the application methods of protective coating</p> <p>6.9 Explain electro-motive chart of corrosion</p> <p>6.10 Describe the process of vacuum metalizing</p>	04	06
7	<p>ELECTROPLATING</p> <p>7.1 Explain electroplating</p> <p>7.2 Narrate the objectives of electroplating</p> <p>7.3 Describe pre-preparation steps of electroplating</p> <p>7.4 Explain pickling, polishing and bobbing for electroplating</p> <p>7.5 State electro-polishing and ultrasonic cleaning</p> <p>7.6 Describe the construction of electroplating equipment</p> <p>7.7 Interpret the application method of electroplating</p> <p>7.8 Mention electroplating machinery and accessories</p> <p>7.9 Discuss hazards of electroplating</p>	03	06
8	<p>SURFACE TREATMENT PROCESSES</p> <p>8.1 Define surface treatment</p> <p>8.2 State the necessity of surface treatment</p> <p>8.3 Explain various surface treatment processes</p> <p>8.4 Describe the importance of cleaning for surface treatment</p> <p>8.5 Illustrate anodic and cathodic coating</p> <p>8.6 Interpret the methods of electro-deposition</p> <p>8.7 Explain hot dipping and metal spray processes</p> <p>8.8 Explain metal cladding and anodized coating</p> <p>8.9 Describe the electro-static coating process</p> <p>8.10 Differentiate between paints and varnishes</p>	04	06
9	<p>POLYMERIC MATERIALS</p> <p>9.1 Define polymer and polymerization</p>	03	06

	<p>9.2 Classify polymer and polymerization</p> <p>9.3 State the addition and condensation polymerization with molecular formula</p> <p>9.4 Mention the ingredients of polymer</p> <p>9.5 Describe the characteristics of polymer</p> <p>9.6 Mention the source of the raw materials of polymer</p> <p>9.7 Describe the different manufacturing procedures of polymer</p> <p>9.8 Mention the application of polymers</p> <p>9.9 Mention the usages limitation of polymer</p> <p>9.10 List the Effects of polymers on environments</p>		
10	<p>PLASTIC MATERIALS</p> <p>10.1 Define plastics</p> <p>10.1 State the different types of plastics</p> <p>10.2 Differentiate between thermo-plastics and thermosetting plastics</p> <p>10.3 State the characteristics of plastic</p> <p>10.3 Mention the ingredients of plastic</p> <p>10.4 Name the different components of die and mold</p> <p>10.5 Describe Compression molding, Extrusion molding methods, Compression molding, Extrusion molding, Transfer molding, Injection molding, Laminating plastics, blow molding and Vacuum forming</p> <p>10.6 Describe the mechanical fasteners, welding of plastics and Solvent joining of plastics</p> <p>10.7 State joining of plastics, mechanical fasteners, welding of plastics and solvent</p> <p>10.8 Narrate the importance of recycling the plastic</p> <p>10.9 Mention the uses of plastic materials</p> <p>10.10 List the Effects of plastic on environments</p>	04	08
11	<p>FUNDAMENTAL ASPECTS OF GLASS</p> <p>11.1 State the characteristics of glass</p> <p>11.2 Mention the ingredients of glass</p> <p>11.3 Explain the controlling parameter of glass</p> <p>11.4 Describe powder formation of glass ingredients</p> <p>11.5 Describe the construction of glass melting/annealing furnace</p> <p>11.6 Describe the process of mixing and melting of glass ingredients</p> <p>11.7 Explain fabrication of glass articles</p> <p>11.8 Describe the flame cutting process of glass</p> <p>11.9 Describe the process of annealing of glass articles</p> <p>11.10 Mention the classification of glass products with application</p>	03	06
12	<p>FUNDAMENTAL ASPECTS OF CERAMICS</p>	04	06

	12.1 State the characteristics of ceramics as materials 12.2 Narrate the ingredients of ceramics 12.3 Mention the source of ceramic raw materials 12.4 Explain the controlling parameter of ceramics 12.5 Describe sieving and mixing of ceramic powders 12.6 Describe the process of preparation of ceramic powder 12.7 Describe the forming technique of ceramic products 12.8 Explain screening, de-airing and separating water 12.9 Describe the process of molding, molding, drying, finishing and firing articles 12.10 Mention the classification of ceramic products with application		
13	INTEGRATED MANUFACTURING SYSTEMS 13.1 Define Integrated Manufacturing Systems 13.2 State Material Handling 13.3 State the different types of Material Handling 13.4 Describe fundamentals of Production Lines 13.5 Describe Manual Assembly Lines 13.6 Describe Automated Production Lines 13.7 State Computer Integrated Manufacturing	03	06
14	FLEXIBLE MANUFACTURING SYSTEMS (FMS) 14.1 Define Flexible manufacturing system (FMS) 14.2 State requirement of FMS 14.3 Describe flexible manufacturing cell (FMC) 14.4 Mention Components of FMS 14.5 List the Advantages of FMS	02	06
15	QUALITY CONTROL AND INSPECTION 15.1 Define Product Quality control and inspection 15.2 State Product Quality control and inspection 15.3 Describe Process Capability and Tolerances 15.4 Illustrate Statistical Process Control 15.5 Describe Quality Programs in Manufacturing 15.6 Explain Modern Inspection Technologies	03	06
	Total	48	90

RECOMMENDED BOOKS:

SL No.	Book Name	Writer Name	Publisher Name & Edition
01	Manufacturing Science	Ghosh and Mallick AK	
02	Manufacturing Technology	RAO PN	
03	Introduction to Manufacturing Processes	Schey J	
04	Material and Processes in Manufacturing	De Garmo EP and Black JT	

05	Fundamentals of Modern Manufacturing Materials Processes and Systems	Mikell P. Groover	Fourth Edition (John Wiley & Sons, inc.)
06	Manufacturing Processes	H.N. Gupta	Second Edition

WEBSITE REFERENCES:

SL No	Web Link	Remarks
01	https://www.youtube.com/watch?v=Um_g8sQ_p3Y	Manufacturing process
02	https://www.youtube.com/watch?v=9uT7Oc500Fc	Types of manufacturing process
03	https://www.youtube.com/watch?v=h2RiLz1-v4Q	Process casting
04	https://www.youtube.com/watch?v=Gun5Kr-lmls	Milling Operations (Animation)

Board may rearrange marks distribution for question setting (If necessary)

SUBJECT CODE	SUBJECT NAME	PERIOD PER WEEK		CREDIT
28567	PROGRAMMING IN C	T	P	C
		2	3	3

Rationale	<p>The C language is a middle-level language that is used in developing system applications and software that can be used in both high-level and low-level languages. C is a procedure oriented computer programming language which means to create lists of instructions for a computer to follow to solve specific problem or in other word to develop computer software. In this article, before starting anything about C language, first learn why to learn C (?) programming language out of these thousands programming language currently in use.</p> <p>C is a powerful general purpose computer programming language which is applicable across different platforms. Another important thing about C programming is that programs written in C are highly portable which means program written in one machine can be moved to other which is very important and powerful feature of programming language. The students should acquire knowledge, skills and attitude about C because it has won widespread acceptance and it gives programmer maximum control and efficiency.</p>
Learning Outcome (Theoretical)	<p>After undergoing the subject, students will be able to</p> <ul style="list-style-type: none"> • State the basic structure of C program and programming style . • Describe algorithm and flow chart. • Describe data types, constants and variables. • Explain the operators and expressions. • Explain the input, output and formatted I/O operations. • Describe the branching and looping statements. • Explain the arrays, pointers and preprocessors. • Explain the functions, structures and union. • Describe file operations.
Learning Outcome (Practical)	<p>After undergoing the subject, students will be able to</p> <ul style="list-style-type: none"> • Perform to add, subtract, multiply, division and modulus among three or more numbers. • Perform to calculate area of a circle, triangle, sphere, ellipse, rectangle, square. • Perform to convert celcius to fahrenheit and vice versa, inch to centimeter and day to month to year etc. • Perform to solve quadratic equation. • Perform to find out prime numbers, fibonacci numbers, odd numbers, even numbers, factorial numbers etc. • Perform to add and multiply one and two dimensional matrix. • Perform file operation (Read, Append and Write mode). • Calculate a series of n numbers using branching and looping statements. • Find out year whether it leap year or not. • Perform vowels/consonants find out by using switch case statements.

DETAILED SYLLABUS (THEORY)

Unit	Topics with Contents	Class (1 Period)	Final Marks
1.	Fundamentals of C Programming 1.1 Describe the historical development of C Programs. 1.2 Describe the basic structure of C program and programming style . 1.3 Differnatiate between C and other high level languages. 1.4 Explain the process of program planning. 1.5 Describe the algorithm and flow chart. 1.6 State the compiling process of C program. 1.7 Write simple programs using basic structure of C program.	03	06
2	Data types, Constants and Variables 2.1 Describe the data types in C. 2.2 Explain constants and variables in C. 2.3 Describe the keywords and identifiers in C. 2.4 Mention the uses of qualifiers in data types. 2.5 State variables and assign values to variables. 2.6 State the type conversion and type definition in C. 2.7 Write simple programs using constants and variables.	03	08
3	Operators and Expressions 3.1 State operators and classification of operators in C Language. 3.2 Describe the arithmetic, relational, logical, assignment, increment, Decrement and conditional operators. 3.3 Explain the bitwise and special operators and their use. 3.4 Write arithmetic expression & process of evaluation in C. 3.5 Describe the precedence of arithmetic operators in C. 3.6 Mention operator precedence and associativity. 3.7 Write simple programs using operators and expressions.	03	08
4	Input and Output operations 4.1. Describe the statements getting input from keyboard. 4.2. Describe the statements printing output on screen and printer. 4.3 State the codes used for formatted I/O statements. 4.4 Mention the escape sequence in C. 4.5 Write programs using I/O statements.	03	04
5	Branching and Looping statements 5.1 Describe the conditional and unconditional branching flow statements. 5.2 State the statement for conditional and unconditional branching statements. 5.3 Explain the format for branching statements. 5.4 Describe the conditional and unconditional looping flow statements. 5.5 State the statement for conditional and unconditional looping. 5.6 Explain the format for looping statements. 5.7 Explain the use of break and continue statement. 5.8 Write programs using branching and looping statements.	04	08
6	Arrays and Pointers 6.1 Define arrays. 6.2 Describe the dimension of arrays. 6.3 Initialize arrays. 6.4 Write programs using arrays. 6.5 Define pointer. 6.6 Describe the characteristics of pointer. 6.7 Explain pointer expressions. 6.8 Write programs using pointers.	04	06
7	Preprocessor statements in C 7.1 Describe the preprocessor directives and their functions.	03	04

	<p>7.2 Define header file and list standard header files.</p> <p>7.3 Describe the process of including header file in routine.</p> <p>7.4 Explain the use of macro.</p> <p>7.5 Describe the advantage of macros over functions in programs.</p> <p>7.6 Write the programs using preprocessor statements.</p>		
8	<p>Functions</p> <p>8.1 Explain library function and user defined function.</p> <p>8.2 Create and call a function.</p> <p>8.3 Describe the process of calling functions and returning values from functions in C.</p> <p>8.4 Describe arguments used in functions.</p> <p>8.5 Mention the functions of prototype.</p> <p>8.6 Write programs using library function and user defined function.</p>	03	06
9	<p>Structure and Union</p> <p>9.1 Describe structure and union.</p> <p>9.2 Mention the structure and union declaration.</p> <p>9.3 Create and access structure members.</p> <p>9.4 Distinguish between structure and union.</p> <p>9.5 Write simple programs using structure and union.</p>	03	05
10	<p>File operations</p> <p>10.1 Describe file operations.</p> <p>10.2 State the modes of opening files.</p> <p>10.3 Create and read from a file.</p> <p>10.4 Write and append content to a file.</p> <p>10.5 Describe the functions that support character I/O.</p> <p>10.6 Explain the routines for performing formatted I/O to files</p> <p>10.7 Write the programs for reading, writing and editing files.</p>	03	05
	Total	32	60

DETAILED SYLLABUS (PRACTICAL)

Sl.	Experiment Name	Class (3 Period)	Continuous Marks
1	<p>Create, compile, debug & execute a C program</p> <p>1.1 Print a message.</p> <p>1.2 Add two integer/float numbers.</p> <p>1.3 Maintain the record of performed task.</p>	1	3
2	<p>Create, compile, debug & execute a C program using constants and variables</p> <p>2.1 Calculate the average of N numbers.</p> <p>2.2 Convert the given temperature in Fahrenheit to Celsius and vice versa.</p> <p>2.3 Calculate the area of a circle.</p> <p>2.4 Maintain the record of performed task.</p>	2	3
3	<p>Create, compile, debug & execute a C programs using operators and expressions.</p> <p>3.1 Convert days to month to year.</p> <p>3.2 Calculate the area of a triangle.</p> <p>3.3 Compare two integer numbers.</p> <p>3.4 Maintain the record of performed task.</p>	1	2
4	<p>Create, compile, debug & execute a C program using I/O statements</p> <p>4.1 Read integer/real number.</p> <p>4.2 Find the sum of three floating point numbers from keyboard.</p> <p>4.3 Convert centimeter to inch using scanf () and printf () statements.</p> <p>4.4 Maintain the record of performed task.</p>	1	3

5	Create, compile, debug & execute a C program using Branching Statements. 5.1 Select and print the largest number of three numbers. 5.2 Compute the roots of a quadratic equation. 5.4 Count vowels from a string of ten characters using switch statement. 5.4 Maintain the record of performed task.	2	3
6	Create, compile, debug & execute a C program using Looping Statements 6.1 Print odd or even numbers from N numbers. 6.2 Find the maximum or minimum number from a set of numbers. 6.3 Check whether a number is prime or not. 6.4 Print out prime number series. 6.5 Maintain the record of performed task.	2	3
7	Create, compile, debug & execute a C program using arrays 7.1 Sort numbers in ascending or descending order using one dimensional array. 7.2 Access the elements of array. 7.3 Add, multiply two matrix using multidimensional arrays. 7.4 Print array elements. 7.5 Maintain the record of performed task.	2	2
8	Create, compile, debug & execute a C program using pointers 8.1 Illustrate the use of pointers in arithmetic operations. 8.2 Compute the sum of all elements stored in an array. 8.3 Maintain the record of performed task.	1	2
9	Create, compile, debug & execute a C program using functions 9.1 Calculate the area of a factorial number. 9.2 Sort an array of integer numbers. 9.3 Calculate factorial of any integer using recursive function. 9.4 Maintain the record of performed task.	2	2
10	Create, compile, debug & execute a C program using structure and union. 10.1 Store and retrieve data using structure. 10.2 Store and retrieve data using union. 10.3 Maintain the record of performed task.	1	2
11	Create, compile, debug & execute a C program using files 11.1 Store/read information to/from sequential file. 11.2 Store/read information to/from random file. 11.3 Convert lower case to upper case and vice versa and store using file. 11.4 Maintain the record of performed task.	1	2
	Total	16	25

NECESSARY RESOURCES (TOOLS, EQUIPMENT'S AND MACHINERY):

SI	Tools & Equipment's Name	Quantity
01	Core i 7 or above configuration desktop or laptop	1 no or necessary
02	Turbo C Software	1 no
03	Code::Blocks Software	1 no

RECOMMENDED BOOKS:

SI	Book Name	Writer Name	Publisher Name & Edition
01	Programming in ANSI C	E Balagurusamy	Tata McGraw-Hill
02	Programming with C	Byron Gottfried	McGraw Hill India
03	C: The Complete Reference	Herbert Schildt	Mcgraw Hill Education

04	Object-Oriented Programming in C	Robert Lafore	Sams
05	Programming In C : A Practical Approach	Ajay Mittal	Pearson

WEBSITE REFERENCES:

SI	Web Link	Remarks
01	www.youtube.com	Search here with topics
02	www.google.com	Search here with topics
03	https://www.w3schools.com/c	Search directly
04	https://www.youtube.com/results?search_query=c+programming+bangla+tutorial	Search directly