

4TH SEMESTER



Government of Karnataka
DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION
Curriculum Structure

IV Semester Scheme of Studies- Diploma in Mechanical Engineering

Sl. No.	Course Category / Teaching Department	Course Code	Course Name	Hours per week			Total contact hrs /week	Credits	CIE Marks		SEE Marks		Total Marks	Min Marks for Passing (including CIE marks)	Assigned Grade	Grade Point	SGPA and CGPA	
				L	T	P			Max	Min	Max	Min						
Integrated Courses																		
1	PC/ME	20ME41P	Operations Management	3	1	4	8	6	60	24	40	16	100	40				
2	PC/ME	20ME42P	CNC Programming and Machining	3	1	4	8	6	60	24	40	16	100	40				
3	PC/ME	20ME43P	Product Design and Development	3	1	4	8	6	60	24	40	16	100	40				
4	PC/ME	20ME44P	Elements of Industrial Automation	3	1	4	8	6	60	24	40	16	100	40				
Audit Course																		
5	AU/ME	20ME45T	Indian Constitution	2	0	0	2	2	50	20	-	-	50	20				
Total				14	4	16	34	26	290	116	160	64	450	180				

***PC: Programme Core:: AU-Audit Course:: L: Lecture:: T: Tutorial:: P: Practice**



Government of Karnataka
DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Programme	Mechanical Engineering	Semester	IV
Course Code	20ME41P	Type of Course	Programme Core
Course Name	Operations Management	Contact Hours	8 hours/week 104 hours/semester
Teaching Scheme	L:T:P :: 3:1:4	Credits	6
CIE Marks	60	SEE Marks	40

1. Rationale: The success of any organisation not only depends on quality of its products and services but also depends on the people within it. Thus, an operational manager has to play a prominent role in an organisation with human capital and machines. Therefore, managerial skills are essential for enhancing their employability and career growth. This course is therefore designed to provide basic concepts in operations management, forecasting techniques, capacity planning, aggregate planning, master production schedule, quality, and inventory and supply chain management for effective utilisation of resources and competitive advantage through operational excellence

2. Course Outcomes: On Completion of course, the student will be able to:

CO-01	Prepare a production capacity utilization plan based on demand forecast and available production capacity for a given product.
CO-02	Prepare a master production plan based on a production capacity utilization plan and a material management plan for a given product.
CO-03	Prepare a process plan using time study, motion study and other appropriate methods to ensure process efficiency.
CO-04	Prepare a quality assurance plan based on a given quality model which is suitable for either a product or a service organisation.

3. Course Content

Week	CO	PO*	Lecture (Knowledge)	Tutorial (Activity)	Practice (Skill)
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	01	01	Introduction to Operation Management	Ref Table 1	<ul style="list-style-type: none"> Virtual Tour Organization (You tube) Problems on Productivity
			1. Introduction to Operation Management - Operation Functions		
			2. Evolutions and Historical Events in Operational Management		
2	01	01	3. Productivity and Competitiveness, Strategy and operation	Ref Table 1	<ul style="list-style-type: none"> Problems on Qualitative Forecast - Delphi method, Market Research method Quantitative Forecast - Time series Method a) Moving average (Naive forecast , Simple moving
			DEMAND FORECASTING		
			1.Demand Forecasting- Demand Behavior-Trend Cycle - Seasonal Background - Steps in Forecasting Process		
			2. Short range and Long Range Forecast		
			3. Qualitative Forecast methods		

					Average, Weighted moving Average)
3	01	01	1. Quantitative Forecast methods	Ref Table 1	Problems on b) Exponential smoothing
			2. Seasonal Adjustments		
			3. Forecast Accuracy		
4	01	01	CAPACITY AND AGGREGATE PLANNING 1. Need for Capacity Planning – Capacity expansion Strategies – Capacity planning Models.	Ref Table 1	Problems on •Capacity Planning, •Aggregate planning •Master production Schedule
			2. Aggregate planning- Methods		
			3. Master production Schedule		
5	01	01	PROCESS PLANNING 1. Make or Buy Decision Outsourcing- Factors for Outsourcing decision- Process Selection – Batch , Mass ,Continuous	Ref Table 1	•Virtual Tour on Batch, Mass and continuous Process •Develop an Operation Sheet indicating Process Plan and Process flow chart for a given component.
			Components of e-manufacturing		
			1.Motion Study		
6	03	01	2. Man- Machine chart	Ref Table 1	•Develop Job Process chart with Process Symbols for a given Process. •Develop Man- Machine chart for a given Process. •Case study on Time Study Principles for a given process.
			3. Concepts on Time Study		
7	02	01	INVENTORY MANAGEMENT 1. Elements of Inventory Management- Inventory Costs- Carrying, Ordering and Shortage Costs	Ref Table 1	Problems on •ABC Classification System •Economic Order Quantity Models •The Production Quantity Model
			2.Inventory Control Systems- Continuous Inventory System (Fixed-Order-Quantity System) Periodic Inventory System (Fixed-Time-Period System)		
			3. Concept on ABC Classification, Economic Order Quantity Models, Production Quantity Model		
8	02	01,02	1. Order Quantity for A Periodic Inventory System Order Quantity with Variable Demand	Ref Table 1	Case study on JIT (Eg:Toyoto Production System)
			2. JIT -Pull System		
			3 Kanban's System		
9	02	01	Supply Chain Management 1.Supply Chains Supply Chains for Service Providers	Ref Table 1	Study on •The Bullwhip Effect •Risk Pooling •Green Supply Chains
			2.Value Chains The Management of Supply Chains		
			3.Vendor Selection- Vendor		

			evaluation and Vendor Development, Negotiations		
10	02	01	1. Supply Chain Uncertainty and Inventory 2. E-Business, Electronic Data Interchange 3. Supply Chain Integration-Collaborative Planning, Forecasting, And Replenishment	Ref Table 1	Study on <ul style="list-style-type: none">• Information Technology: Supply Chain Enabler• Bar Codes• Radio Frequency Identification• Build-To-Order (BTO)
11	02	01,07	1. Material Requirements Planning (MRP) Enterprise Resource Planning (ERP), 2. Warehouse Management Systems Collaborative Logistics, Distribution Outsourcing 3. Finance/Accounting-Sales/Marketing-Production/Materials Management-Human Resources		Case study on Procurement-Outsourcing. <ul style="list-style-type: none">• E-Procurement• E-Market places• ERP MODULES
12	04	01,04,07	QUALITY MANAGEMENT 1. Quality from The Customer's Perspective Dimensions of Quality for Manufactured Products Dimensions of Quality for Services 2. Quality from The Producer's Perspective A Final Perspective On Quality The Cost of Quality The Cost of Achieving Good Quality 3. The Cost of Poor Quality The Quality-Productivity Ratio Quality Management System	Study the latest technological changes in this course and present the impact of these changes on industry	Practice on Quality Tools <ul style="list-style-type: none">• Process Flowcharts• 5 Whys, Cause-And-Effect Diagrams• Check sheets And Histograms• Pareto Analysis• Scatter Diagrams
13	04	04,05,07	1. TQM and QMS The Focus of Quality Management—Customers 2. Quality Management in The Supply Chain The Role of Employees in Quality Improvement Kaizen and Continuous Improvement Quality Circles 3. Process Improvement Teams Six Sigma The Breakthrough Strategy: DMAIC		Practice on The Deming Wheel (PDCA Cycle) <ul style="list-style-type: none">• Process Control Charts• Statistical Quality Control• ISO 9000• ISO14000
Total in hours			39	13	52

- *PO= Program Outcome as listed and defined in year 1 curriculum
- Course Co-Ordinator must prepare PO – CO mapping with strength (Low/Medium/High) before course planning

Table 1: Suggestive Activities for Tutorials: (The List is only shared as an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic and on the availability of such resources at their institution)

Sl.No.	Suggestive Activities for Tutorials																		
01	<p>Below are monthly sales of light bulbs from the lighting store.</p> <table border="1"> <thead> <tr> <th>MONTH</th><th>Jan</th><th>Feb</th><th>March</th><th>April</th><th>May</th><th>June</th></tr> </thead> <tbody> <tr> <td>SALES</td><td>50</td><td>200</td><td>80</td><td>40</td><td>360</td><td></td></tr> </tbody> </table> <p>Forecast sales the following</p> <ul style="list-style-type: none"> • Naive method • Three- month simple moving average • Three-month weighted moving average using weights of 0.5, 0.3 and 0.2 • Exponential smoothing using an alpha of 0.2 and a May forecast of 350. <p style="text-align: right;">for June using</p>	MONTH	Jan	Feb	March	April	May	June	SALES	50	200	80	40	360					
MONTH	Jan	Feb	March	April	May	June													
SALES	50	200	80	40	360														
02	<p>Delph Manufacturing Company is going to purchase an auto parts component from one of two competing suppliers. Delph is going to base its decision, in part, on the supply chain performance of the two suppliers. The company has obtained the following data for average raw materials, work-in-process, and finished goods inventory value, as well as cost of goods sold for the suppliers</p> <table border="1"> <thead> <tr> <th>Items</th><th>Supplier 1</th><th>Supplier 2</th></tr> </thead> <tbody> <tr> <td>Cost of goods sold</td><td>Rs 8,360,000</td><td>14,800,000</td></tr> <tr> <td>Raw materials</td><td>270,000</td><td>870,000</td></tr> <tr> <td>Work-In-Progress</td><td>62,000</td><td>550,000</td></tr> <tr> <td>Finished goods</td><td>33,000</td><td>150,000</td></tr> </tbody> </table> <p>Each company operates 52 weeks per year. Determine which supplier has the best supply chain performance according to inventory turns and weeks of supply. What other factors would the company likely take into account in selecting a supplier?</p>	Items	Supplier 1	Supplier 2	Cost of goods sold	Rs 8,360,000	14,800,000	Raw materials	270,000	870,000	Work-In-Progress	62,000	550,000	Finished goods	33,000	150,000			
Items	Supplier 1	Supplier 2																	
Cost of goods sold	Rs 8,360,000	14,800,000																	
Raw materials	270,000	870,000																	
Work-In-Progress	62,000	550,000																	
Finished goods	33,000	150,000																	
03	<p>The maintenance department for a small manufacturing firm has responsibility for maintaining an inventory of spare parts for the machinery it services. The parts inventory, unit cost, and annual usage are as follows</p> <table border="1"> <thead> <tr> <th>Part</th><th>Unit Cost(Rs)</th><th>Annual Usage</th></tr> </thead> <tbody> <tr> <td>1</td><td>100</td><td>90</td></tr> <tr> <td>2</td><td>350</td><td>40</td></tr> <tr> <td>3</td><td>30</td><td>130</td></tr> <tr> <td>4</td><td>20</td><td>180</td></tr> <tr> <td>5</td><td>320</td><td>50</td></tr> </tbody> </table> <p>The department manager wants to classify the inventory parts according to the ABC system to determine which stocks of parts should most closely be monitored</p>	Part	Unit Cost(Rs)	Annual Usage	1	100	90	2	350	40	3	30	130	4	20	180	5	320	50
Part	Unit Cost(Rs)	Annual Usage																	
1	100	90																	
2	350	40																	
3	30	130																	
4	20	180																	
5	320	50																	
04	<p>The design capacity for engine repair in our company is 80 trucks/day. The effective capacity is 40 engines/day and the actual output is 36 engines/day. Calculate the utilization and efficiency of the operation. If the efficiency for next month is expected to be 82%, what is the expected output?</p>																		
05	<p>County school buses are inspected every month for "defects." In a recent monthly inspection, 27 worn or torn seats were found, 22 buses had dirty floors, there were 14 cases of exterior scratches and chipped paint, there were 8 cracked or broken windows, the engines on 4 buses had trouble starting or were not running smoothly, and 2 buses had faulty brakes. Develop a Pareto chart for the bus inspections and indicate the most significant quality-problem categories. What does this tell you about the limitations of applying Pareto chart analysis? How might these limitations be overcome in Pareto chart analysis</p>																		
06	Study and prepare a report on Inventory management in A Super Bazaar																		
07	Case study on Supply chain Management in Amazon, Flikart etc																		
08	Case study on use of ERP in An Education Institution (From Admission to Award of Degree)																		
09	Case study on logistics management in Swiggy, Zomoto, Dunzo etc																		

4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3	CIE-3 Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill test reduced to 20
5	CIE-5 Skill Test-Practice	12	180	100	
6	CIE-6 Portfolio continuous evaluation of Tutorial sessions through Rubrics	1-13		10	10
Total CIE Marks					60
Semester End Examination (Practice)		180	100	40	
Total Marks					100

5. Format for CIE written Test

Course Name	Operation Management	Test	I/II/III	Sem	IV
Course Code	20ME41P	Duration	80 Min	Marks	30
Note: Answer any one full question from each section. Each full question carries 10 marks.					
Section		Assessment Questions		Cognitive Levels(R/U/A)	Course Outcome
I	1				
	2				
II	3				
	4				
III	5				
	6				

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.

5 . (a) For CIE Skill Test -4

Duration: 240Min

SL. No.	CO	Particulars/Dimension	Marks
1	01	One Question- Problems/Case study on Demand forecasting/Master Scheduling/Capacity Planning	45
2	01,03	Based on the given Case Study, Prepare a Job Process chart with Process Symbols/Develop a Man- Machine chart	45
3	01,03	Portfolio evaluation based on the average of all Practice Sessions (1-6 Weeks)	10
Total Marks			100

5 . (b) For CIE Skill Test -5

Duration: 240 Min

SL. No.	CO	Particulars/Dimension	Marks
1	02	One Question on Inventory Management and Supply Chain Management (JIT/ Kanban System /E- Business/)	45
2	04	For the given case study , Prepare the Cost of achieving good Quality using any quality Tools	45
3	02,04	Portfolio evaluation based on the average of all Practice Sessions (7-12 weeks)	10
Total Marks			100

6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
		Average Marks= $(8+6+2+2)/4=4.5$					5

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

7. Reference:

Sl. No.	Description
1	Production and Operations Management – Creating Value along the Supply Chain By Russel and Taylor , Wiley Publications , 7 Edition
2	Modern Production and Operation Management By Buffa and Sarin, Wiley Publications, 8 edition
3	Production and Operations Management By Chary, Tata Mc Graw Hill Publications
4	Production and Operations Management- Concepts, Models and Behaviour By Adam and Ebert, Prentice Hall Publications

8. LIST OF SOFTWARES/ LEARNING WEBSITES:

- www.youtube.com/watch?v=SF53ZZsP4ik
- www.youtube.com/watch?v=iPZlQ3Zx5zc

9. SEE Scheme of Evaluation

Duration :180 Min

SL. No.	CO	Particulars/Dimension	Marks
1	O1,02,03	One Question- Problems/Case study on Demand forecasting/Master Scheduling/Capacity Planning OR Based on the given Case Study, Prepare a Job Process chart with Process Symbols/Develop a Man- Machine chart	40
2	O3,04	One Theory Question on Inventory Management and Supply Chain Management (JIT/ Kanban System /E- Business/) OR For the given case study , Prepare the Cost of achieving good Quality using any quality Tools	40
3	01,0203,04	Viva voce	20
	Total Marks		100

10. Tools/ Equipment/ Software's Required

- ERP Software



Government of Karnataka
DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Programme	Mechanical Engineering	Semester	IV
Course Code	20ME42P	Type of Course	Programme Core
Course Name	CNC Programming and Machining	Contact Hours	8 hours/week 104 hours/semester
Teaching Scheme	L:T:P :: 3:1:4	Credits	6
CIE Marks	60	SEE Marks	40

1. Rationale: In recent years the manufacturing environment has undergone dramatic change. For achieving market goals, it is essential to produce quality parts in less time. Evolution of information technology, variety manufacturing concepts with zero lead time demand and quality consciousness have supported fast adaption of computerized numerical control (CNC) machines. As in human beings' mental ability is becoming more important than physical ability to do the manual work, similarly CNC programming in the same way has more importance along with selection and use of CNC tooling. In this course therefore an attempt has been made to develop skills required for programming, tooling etc for CNC machine. CNC machines normally are not limited to machine tools only but realm of CNC has widened in almost all areas of manufacturing, processes and support activities. It is therefore very important for Diploma mechanical engineers to master CNC technology.

2. Course Outcomes/Skill Sets: At the end of this course, student will be able to:

CO-01	Identify various components of a CNC machine and list the use of those components for any given CNC operation.
CO-02	Study a given production drawing and list the right tools needed to produce a product as per the drawing.
CO-03	Write a CNC turning and milling program for a given production drawing, simulate the program and execute the program in production mode.
CO-04	Develop and/or import a 3-D model of a given component drawing, generate the CNC programming codes using CAM software and execute the program in production mode.

3. Course Content

Week	CO	PO*	Lecture (Knowledge)	Tutorial (Activity)	Practice (Skill)
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	01	01	1.Introduction to CNC Machines- Advantages of CNC machines over Conventional machines 2.Explain the Construction features of CNC machine- Machine Structure, bed, spindle motor and drive, axes motor and ball screws using Multimedia 3. Explain Guide ways, LM guides, console, control switches, coolant system, hydraulic system using Multimedia	Ref Table 1	1. Demonstrate Personal, Conduct, Shop etiquettes and general safety practices in CNC machine Comply safe handling of CNC machines, tools and Equipment. 2.Demonstration of CNC machine and its parts - bed, spindle motor and drive, axes motor and ball screws, guide ways, LM

					guides, console, control switches, coolant system, hydraulic system, 3. Identification of safety switches, machine over travel limits and emergency stop. Machine starting & operating in Reference Point, JOG and Incremental Modes
2	01,02	01	1.Explain Axis convention of CNC machine 2. Explain Cutting tool materials, cutting tool geometry – insert types, holder types, insert cutting edge geometry. 3. ISO nomenclature for turning tool holders, boring tool holders, indexable inserts. - Tool holders and inserts for radial grooving, face grooving, threading, drilling	Ref Table 1	1.Conduct a preliminary check of the readiness of the CNC machine viz., cleanliness of machine, referencing – zero return, 2.Functioning of lubrication, coolant level, correct working of sub-system
3	01,02	01,04	1.Explain Automatic tool exchanger using Multimedia 2. Explain the importance of Tool length compensation, Tool nose Radius compensation and Tool Wear compensation. 3. Explain Machine Zero and Work Zero	Ref Table 1	1.Perform Work and tool setting: - Job zero/work coordinate system and tool setup and live tool setup 2. CNC machining centre operation in various modes: JOG, EDIT, MDI, SINGLE BLOCK, AUTO 3. Setting the tool offsets, entry of tool nose radius and orientation in CNC console
4	03	01,04	1.Explain Programming sequence and format - Absolute and Incremental System 2.Explain G codes and M codes 3. Explain Linear interpolation and Circular Interpolation	Ref Table 1	1. Geometry Wear Correction. Geometry and wear offset correction in CNC Console 2. Program checking in dry run, single block modes
5.	03	01	1.Explain cutting Parameters – Feed, Speed and depth of cut w.r.t CNC machine as per Catalogue 2. Explain Canned Cycle, Mirroring and Subroutines	Ref Table 1	1.Learn various numerical keys, Address Keys, functional Keys of operational console
6.	03	01,04	Write the Part Program for Facing, Turning, Step turning and Taper turning (Write Program for 3 models and execute any one on the machine)	Ref Table 1	1.Input the Program into the Simulator and operate the Simulator 2.Transfer the simulated Program to machine

					3.Set the machine with necessary tools and Job 4. Execute the Program in Auto mode to produce the Job.
7.	03	01,04	Write the Part Program for Turning, Profile turning and Thread cutting (Write Program for 3 models and execute any one on the machine)	Ref Table 1	1.Input the Program into the Simulator and operate the Simulator 2.Transfer the simulated Program to machine 3.Set the machine with necessary tools and Job 4.Execute the Program in Auto mode to produce the Job
8.	03	01,04	Write a CNC milling program for Pocket machining (Write Program for 3 models and execute any one on the machine)	Ref Table 1	1.Input the Program into the Simulator and operate the Simulator 2.Transfer the simulated Program to machine 3.Set the machine with necessary tools and Job 4.Execute the Program in Auto mode to produce the Job
9	03	01,04	Write a part program for drilling 4 holes in a plate Six holes along PCD on a circular plate	Ref Table 1	1.Input the Program into the Simulator and operate the Simulator 2.Transfer the simulated Program to machine 3.Set the machine with necessary tools and Job 4.Execute the Program in Auto mode to produce the Job
10.	03	01,04,07	Write a Program using Mirroring Write a Program using Subroutines	Ref Table 1	1.Input the Program into the Simulator and operate the Simulator 2.Transfer the simulated Program to machine 3.Set the machine with necessary tools and Job 4.Execute the Program in Auto mode to produce the Job

11	04	01,04,07	Generate the Part Program for Component requiring Turning, Step turning Profile turning and Thread cutting by using CAM software (Program for 3 models and execute any one on the machine)		1.Transfer the simulated Program to machine 2. Set the machine with necessary tools and Job 3. Execute the Program in Auto mode to produce the Job
12	04	01,04,07	Generate a CNC program for component having Pocket machining using CAM software (Program for 3 models and execute any one on the machine)	Study the latest technological changes in this course and present the impact of these changes on industry	1. Transfer the simulated Program to machine 2. Set the machine with necessary tools and Job 3. Execute the Program in Auto mode to produce the Job
13			Demonstrate the manufacturing of following components on CNC machines using YouTube Videos <ol style="list-style-type: none">1. CNC Turning2. Rollers3. Spacers4. Brackets Discuss and Prepare a Report on the videos Presented for each manufactured component		Demonstrate the manufacturing of following components on CNC machines using YouTube Videos <ol style="list-style-type: none">1. Spindles2. Frames3. Engine Block4. Ball Bearings Discuss and Prepare a Report on the videos Presented for each manufactured component
Total in hours			39	13	52

- *PO= Program Outcome as listed and defined in year 1 curriculum
- Course Co-Ordinator must prepare PO – CO mapping with strength (Low/Medium/High) before course planning

Table 1: Suggestive Activities for Tutorials: (The List is only shared as an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic and on the availability of such resources at their institution)

Sl.No.	Suggestive Activities for Tutorials
01	Discuss the steps for choosing the Right CNC machine tool using various parameters like operator experience, Material to be cut, Part difficulty and complexity, LM guides, Control systems, Cost per part, Availability of space. www.hwaheonasia.com
02	Presentation on Macros and Parametric Programming in CNC by discussing basic macro skill- Macro capability, common features and applications- Macro structure www.thomasnet.com
03	Discuss and present a report on influence of coolant in CNC by explaining Purpose- delivery methods of coolants- Types of coolants- Health and safety issues- Properties- Recycling and disposal of cutting lubricants www.Industr.com
04	Each student has to Present minimum 5 CNC Programming on Machining involving Turning, Milling and Drilling. (Course coordinator has to ensure no repetition of the Programs)

4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3	CIE-3 Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill test reduced to 20l tests 20
5	CIE-5 Skill Test-Practice	12	180	100	
6	CIE-6 Portfolio continuous evaluation of Tutorial sessions through Rubrics	1-13		10	10
Total CIE Marks					60
Semester End Examination (Practice)			180	100	40
Total Marks					100

5. Format for CIE written Test

Course Name	Operation Management	Test	I/II/III	Sem	IV
Course Code	20ME41P	Duration	80 Min	Marks	30
Note: Answer any one full question from each section. Each full question carries 10 marks.					
Section		Assessment Questions		Cognitive Levels(R/U/A)	Course Outcome
I	1				
	2				
II	3				
	4				
III	5				
	6				

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.

5 . (a) CIE Skill Test -4

Duration: 240 Min

SL. No.	CO	Particulars/Dimension	Marks
1	02,04	One Question on Writing CNC program For Turning Model ,Simulation and Preparation of the MODEL on CNC Machine <ul style="list-style-type: none"> • Writing CNC program—30 Marks • Editing the program—30 Marks • Simulation and Preparation of the MODEL on CNC Machine - 30 Marks 	90
2	02,04	Portfolio evaluation based on the average of all Practice Sessions (1-6 Weeks)	10
Total Marks			100

5 . (b) CIE Skill Test -5

Duration: 240 Min

SL. No.	CO	Particulars/Dimension	Marks

1	02,03	One Question on Writing CNC program For Milling Model ,Simulation and Preparation of the MODEL on CNC Machine <ul style="list-style-type: none"> • Writing CNC program—25 Marks • Editing the Program—15 Marks • Simulation and Preparation of the MODEL on CNC Machine-10 Marks 	50
2	02,04	One Question on Generating CNC Turning Program/Milling Program, Using CAM Software, Simulation and Preparation of the MODEL on CNC Machine. <ul style="list-style-type: none"> • Preparation of Solid Model for a given Drawing using software - 25 marks • Generate Turning Program/Milling Program, Using CAM Software - 05 Marks • Interface with the CNC machine and produce the model -10 Marks 	40
3	02,03,04	Portfolio evaluation based on the average of all Practice Sessions (7-12 Weeks)	10
Total Marks			100

6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
Average Marks= (8+6+2+2)/4=4.5							5

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

7. Reference:

Sl. No.	Description
1	Automation, Production Systems, and Computer- Aided Manufacturing by Mikell P. Groover Prentice-Hall International publication
2	CAD/CAM Principles and Applications P N Rao McGraw Hill Education
3	CNC Machines. Pabla B.S., Adithan M. New Age International, New Delhi,2014(reprint)
4	Computer Numerical Control-Turning and Machining centers. Quesada Robert Prentice Hall 2014

8. LIST OF SOFTWARES/ LEARNING WEBSITES:

- 1.<http://www.nptel.ac.in>
- 2.<http://www.youtube.com/watch?v=M3eX2PKM1RI>
- 3.<http://www.youtube.com/watch?v=EHQ4QIDqENI&list=PLBkqkLQO2nAt5MNLo>
- 4.http://www.youtube.com/watch?v=hJFLcvtiNQ_I
- 5.<http://www.youtube.com/watch?v=BIM1AyxfYkw> .
- 6.<http://www.mtabindia.com>
- 7.<http://www.swansoftcnccsimulator.com>

9. SEE Scheme of Evaluation

Duration: 180 Min

SL. No.	CO	Particulars/Dimension	Marks

1	02,03	<p>One Question on Writing CNC program For Turning Model ,Simulation and Preparation of the MODEL on CNC Machine</p> <ul style="list-style-type: none"> • Writing CNC program—30 Marks • Simulation and Preparation of the MODEL on CNC Machine-20Marks <p>OR</p> <p>One Question on Writing CNC program For Milling Model ,Simulation and Preparation of the MODEL on CNC Machine</p> <ul style="list-style-type: none"> • Writing CNC program—30 Marks • Simulation and Preparation of the MODEL on CNC Machine-20 Marks 	50
2	02,04	<p>One Question on Preparing a Solid Model and Generating CNC Turning Program/Milling Program, Using CAM Software,</p> <ul style="list-style-type: none"> • Preparation of Solid Model for a given Drawing using software – 20 marks • Generate CNC Turning Program/Milling Program, Using CAM Software - 10Marks 	30
3	01,02,03,04	Viva voce	20
Total Marks			100

10. Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
01	CNC Turning Centre (Tutor or Productive)	Minimum diameter 25 mm, Length 120 mm with ATC. (Approximate)	01
02	CNC Milling Centre (Tutor or Productive) X axis travel - 225 mm, Y axis travel - 150 mm, Z axis travel - 115 mm, With ATC.(Approximate)	X axis travel - 225 mm, Y axis travel - 150 mm, Z axis travel - 115 mm, With ATC.(Approximate)	01
03	Simulation software likes: CNC Simulator Pro, Swansoft CNC, etc.		20 user
04	Latest version of CAD/CAM integration software like MASTER CAM, NX CAM OR EDGE CAM		20 user
05	Desk top computer	Latest configuration	20 no



Government of Karnataka
DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Programme	Mechanical Engineering Diploma	Semester	IV
Course Code	20ME43P	Type of Course	Programme Core
Course Name	Product Design and Development	Contact Hours	8 hours/week 104 hours/semester
Teaching Scheme	L:T:P :: 3:1:4	Credits	6
CIE Marks	60	SEE Marks	40

1. Rationale: Design department of industry is one of the major job areas for Diploma engineers. The fundamental knowledge of Strength of Materials, Engineering Materials, and Computer Aided Design and Drafting is essential to meet job requirement in this sector. To enable a student to work here, they should know how to design a simple machine element, usual procedures in development of product, fundamental knowledge in design of simple machine elements such as shafts, springs, couplings etc, codes, norms, standards and guidelines for selection of appropriate material. In addition to this, Diploma engineers are required to read and interpret the drawings. Therefore, it is essential that they have competency in preparing drawings of machine parts. This course aims at developing analytical abilities in the student to give solutions to simple engineering design problems using standard procedures. Hence this course has been introduced with the expectations that efforts will be made to provide appropriate learning experiences in the use of basic principles to the design solution for applied problems to develop the required skill and competencies.

2. Course Outcomes/Skill Sets: At the end of the Course, the student will be able to:

CO-01	Explain the key principles of product design considering Strength, Aesthetic and Ergonomic
CO-02	Design simple machine elements like shafts, springs, couplings and knuckle joints using standard data.
CO-03	Prepare CAD Part and Assembly drawings for couplings and knuckle joints based on designed parameter.
CO-04	Produce Component based on designed Parameters using 3- D Printing Techniques

3. Course Content

Week	CO	PO*	Lecture (Knowledge)	Tutorial (Activity)	Practice (Skill)
			3 hours/week	1 hour/week	4 hours/week (2hours/batch twice in a week)
1	01	01	Product Development and Design: 1.Explain Product Development- Stages of Product Development- Need and Feasibility study 2.Explain Development of design- Selection of Materials and Process 3.Explain Prototype -launching of product -Product life cycle	Ref Table 1	Discuss case studies of Product development by using Video
2	01	01	General consideration in design: Based on <ul style="list-style-type: none">• Functional requirement• Effect on environment• Life, Reliability, Safety	Ref Table 1	Case study

			<ul style="list-style-type: none"> • Principles of Standardization • Assembly Feasibility • Maintenance-Cost-Quantity • Legal issues and Patents • Aesthetic and Ergonomic factors • Choice of Materials • Feasibility of Manufacturing Processes 		
3	01	01	<p>Aesthetic and Ergonomic consideration in Design:</p> <ul style="list-style-type: none"> • Explain Aesthetic considerations- Basic types of product forms, Designing for appearance, shape, Design features, Materials, Finishes, proportions, Symmetry Contrast etc. • Morgan's color code. • Ergonomic considerations- Relation between man, machine and environmental factors. Design of displays and controls. 	Ref Table 1	Case Study on Ergonomics and Aesthetic design principles.
4	02	03,04	<p>Torsion of Shaft:</p> <ol style="list-style-type: none"> 1.Assumptions in Shear stress in a shaft subjected to torsion – Strength and Rigidity (Solid and Hollow shaft) 2.Power Transmitted by Solid and Hollow shaft - ASME and BIS Code for power Transmission 3.Problems on Shafts subjected to only Shear based on Rigidity and Strength 	Ref Table 1	1. Validate the Problems on Shafts for Strength and Rigidity using Ansys (One each on Strength and Rigidity)
5	02	03,04	<ol style="list-style-type: none"> 1.Problems on Shafts subjected to only Shear based on Rigidity and Strength 2.Problems on Shaft subjected to only Bending 3. Problems on Shaft subjected to only Bending 	Ref Table 1	<ol style="list-style-type: none"> 1. Recap of CAD commands 2.Practice on Section of Solids- <ol style="list-style-type: none"> a)Prisms b) Pyramid
6	02	03,04	<ol style="list-style-type: none"> 1 Problems on Shaft subjected to combined Shear and Bending. 2.Problems on Shaft subjected to combined Shear and Bending 3.Problems on Shaft subjected to combined Shear and Bending 	Ref Table 1	<ol style="list-style-type: none"> 1. Practice on Section of Solids- <ol style="list-style-type: none"> a)Cylinder b) Cone
7	02,03	03,04	<p>Springs:</p> <ol style="list-style-type: none"> 1. Classification of springs- Application of springs- Leaf springs –Application 	Ref Table 1	Sections on Simple Machine Elements (CAD) <ol style="list-style-type: none"> a) Sectional front view, Front view with

			2.Terminology of Helical spring- Materials and Specification of springs 3. Design of helical spring		Right half in Section, Front view with Left half in Section b) Sectional Top View c) Sectional Side View
8	02,03	03,04	Design of helical spring	Ref Table 1	Sections on Simple Machine Elements (CAD) a) Sectional front view, Front view with Right half in Section, Front view with Left half in Section b) Sectional Top View c) Sectional Side View
9	02,03	03,04	Coupling: Design of Muff coupling	Ref Table 1	Using CAD, prepare Part Models for Muff coupling based on designed parameter and assemble the same. Extract the Sectional views for the above machine element indicating Surface Texture and Bill of Materials
10	02,03	03,04	Design of Protected type Flange Coupling	Ref Table 1	Using CAD, prepare Part Models for Protected type Flange Coupling based on designed parameter and assemble the same. Extract Sectional views for the above machine element indicating Surface Texture and Bill of Materials
11	02,03,	03,04,07	Design of Knuckle Joint		Using CAD, prepare Part Models for Knuckle Joint based on designed parameter and assemble the same. Extract Sectional views for the above machine element indicating Surface Texture and Bill of Materials
12	04	03,04,07	3D Printing 1. Introduction, Process, Classifications, Advantages of		

			<p>additive over conventional Manufacturing, Applications, Modelling for Additive Manufacturing</p> <p>2. Additive Manufacturing Techniques, 3D Printing Materials and its forms, Post Processing Requirement and Techniques.</p> <p>3. Product Quality, Inspection and Testing, Defects and their causes, Additive Manufacturing Application Domains</p>	<p>Study the latest technological changes in this course and present the impact of these changes on industry</p>	<p>Preparation of 3D Printer for printing – Modelling, Saving CAD file into STL file, Slicing, Material loading and printing parameter selection</p>
13	04	03,04,07	<p>1. Working of Fused Deposition Modelling (FDM) Machine- Single and Multi Nozzle printers, Machine Configuration- Cartesian, Delta, Polar and robotic arm configuration 3D printers</p> <p>2. Common FDM materials- PLA, ABS, PA, TPU,PETG, PEEK and PEI, Printer Parameters - Temperature of the nozzle and the platform, the build speed, the layer height, Warping, Layer Adhesion, Support Structure, In-fill & Shell Thickness</p> <p>3. Benefits & Limitations of FDM, Software Tools- 3D modelling, Slicers & 3D Printer Hosts</p>	<p>Printing of Designed and Modelled component (flange coupling and knuckle joint) on any available 3D printing machine and carryout post processing of additively manufactured product (Inspection and defect analysis).</p>	
Total in hours			39	13	52

- *PO= Program Outcome as listed and defined in year 1 curriculum
- Course Co-Ordinator must prepare PO – CO mapping with strength (Low/Medium/High) before course planning

Table 1: Suggestive Activities for Tutorials: (The List is only shared as an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic and on the availability of such resources at their institution)

Sl.No.	Suggestive Activities for Tutorials
01	Presentation on design of Bicycles for Indian children focusing on Aesthetic and Ergonomics by Explaining market analysis- user study – Problem identification – Product design and specification- Concept generation- Material and Manufacturing Processes- Final concept selection www.sastechjournal.com
02	Presentation on types of suspension springs used in Automobile vehicles by explaining leaf-spring, Coil spring , Torsion Spring, Air bags , Rubber Springs www.theengineerspost.com
03	Presentation on different types of Keys used in Transmission system and importance such as parallel key, Saddle key, Sunk Key , Gib headed key, Feather Key, Woorruff Key with Advantages and applications
04	Presentation on Antifriction Bearing by explaining rolling contact- journal ball bearing construction- Cylindrical bearing – Needle bearing – Foot step Bearing – Plumber Bearing

05	Presentation on Friction Clutches used in Automobiles by explaining parts- Single plate- Multi plate- Purpose -Application
06	The Role of Additive Manufacturing in the Era of Industry 4.0
07	Application of Additive Manufacturing in health care industry

4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3	CIE-3 Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill test reduced to 20
5	CIE-5 Skill Test-Practice	12	180	100	
6	CIE-6 Portfolio continuous evaluation of Tutorial sessions through Rubrics	1-13		10	10
Total CIE Marks					60
Semester End Examination (Practice)			180	100	40
Total Marks					100

5. Format for CIE written Test

Course Name	Production Design and Development	Test	I/II/III	Sem	IV
Course Code	20ME43P	Duration	80 Min	Marks	30

Note: Answer any one full question from each section. Each full question carries 10 marks.

Section	Assessment Questions	Cognitive Levels(R/U/A)	Course Outcome	Marks
I	1			
	2			
II	3			
	4			
III	5			
	6			

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.

5 . (a) For CIE Skill Test -4

Duration: 240 Min

SL. No.	CO	Particulars/Dimension	Marks
1	02	One Question on Design of Shaft Subjected to Strength and Rigidity <ul style="list-style-type: none"> • Fixing the Diameter of Shaft after design ---30 Marks • Validate the Designed parameters of Shaft for Strength and Twisting using Ansys- 30 Marks 	60
2	03	One question on Section of Solids (Prism/Pyramid/Cone/Cylinder) <ul style="list-style-type: none"> • Placing the Section plane and drawing the section – 20 Marks • Extracting the True shape of the Section – 10 Marks 	30
3	01,02,03	Portfolio evaluation based on the average of all Practice Sessions (1-6 Weeks)	10
Total Marks			100

5 . (b)For CIE Skill Test -5

Duration: 240 Min

SL. No.	CO	Particulars/Dimension	Marks
1	03,04	<p>One Question on Design and Assembly drawing of Simple Machine parts like Muff Coupling/Flange Coupling/ Knuckle Joint</p> <ul style="list-style-type: none"> • Design of Simple Machine part by using Data Hand Book --35 Marks • Preparation of Part Models for the Designed values by using CAD Software -- 35 Marks • Assembly of Part Models using CAD software With Bill of Materials - 20 Marks 	90
2	03,04	Portfolio evaluation based on the average of all Practice Sessions (7-12 Weeks)	10
Total Marks			100

6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
Average Marks= (8+6+2+2)/4=4.5							5

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

7. Reference:

Sl. No.	Description
1	A Text book of Machine Design R.S. Khurmi & J.K.Gupta S. Chand publication
2	Machine design S G Kulkarni McGraw Hill Education Publications
3	Introduction to Machine design V B Bhandari McGraw Hill Education Publications
4	Design Of Machine Elements Vol I, Vol II J.B.K. Das , P.L.Srinivas Murthy Sapna Publication
5	Machine Component Design William Orthwein Jaico publication
6	Design Data Hand Book for Mechanical Engineers K Mahadevan & K Balaveera Reddy CBS publications
7	Khanna Editorial, "3D Printing and Design", Khanna Publishing House, Delhi.
8	J.D. Majumdar and I. Manna, "Laser-Assisted Fabrication of Materials", Springer Series in Material Science, 2013
9	D.T. Pham and S.S. Dimov, "Rapid manufacturing: The technologies and applications of rapid prototyping and rapid tooling", London-New York, Springer, 2001
10	Lan Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
11	Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publisher, 2011.
12	CK Chua, Kah Fai Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017

13	L. Lu, J. Fuh and Y.S. Wong, "Laser-Induced Materials and Processes for Rapid Prototyping", Kulwer Academic Press, 2001
14	Zhiqiang Fan And Frank Liou, "Numerical Modelling of the Additive Manufacturing (AM) Processes of Titanium Alloy", InTech, 2012

8. LIST SOFTWARES/WEBSITES

1. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/left_home.html
- 2 http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/left_mod4.html

9. SEE Scheme of Evaluation

Duration: 180 Min

SL. No.	CO	Particulars/Dimension	Marks
1	02,03	One Question on Design and Assembly of Simple Machine parts like Muff coupling/Flange Coupling/ Knuckle Joint <ul style="list-style-type: none"> • Design of Simple Machine part by using Data Hand Book -----35 Marks • Preparation of Part Models for the Designed valves By using CAD Software —25 Marks • Assembly of Part Models By using CAD Software With Bill of Materials--- 20 Marks 	80
2	01,02,03,04	Viva voce	20
Total Marks			100

10. Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
01	Latest version of CAD software	-----	20 user
02	Desk top computer	Latest configuration	20 no's
03	Laser printer	-----	02 no's
04	3-D Printing Machine		01 no



Government of Karnataka
DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Programme	Mechanical Engineering	Semester	IV
Course Code	20ME44P	Type of Course	Programme Core
Course Name	Elements of Industrial Automation	Contact Hours	8 hours/week 104 hours/semester
Teaching Scheme	L:T:P :: 3:1:4	Credits	6
CIE Marks	60	SEE Marks	40

1. Rationale: In present scenario, Manufacturing industries are moving towards complete automation. Small and medium industries are in a phase of switching to PLC and SCADA technology for data acquisition and control. Industrial automation systems are used to control and monitor a process, machine or device in a computerized manner that usually fulfils repetitive functions or tasks. They are intended to operate automatically in order to reduce and improve human work in the industry. Advantages of this technology is commonly attributed to higher production rates and increased productivity, more efficient use of materials, better product quality, improved safety, shorter workweeks for labour, and reduced factory lead times. The Automation Engineer will design, program, simulate and commission automated machines and plant-wide processes to perform many job functions. Depending on the size of the organization, the engineer will perform some or all of these responsibilities. Therefore, it is necessary for diploma engineers to have knowledge of both PLC and SCADA technology. This course attempts to provide basic theoretical and practical aspects of automation technologies to develop operational competency. Hence this course is the foundation for diploma engineers who want to further specialise in the field of industrial automation

2. Course Outcomes: At the end of this course, student will be able to

CO-01	Select the right sensor and/or actuator for automating a given application and demonstrate process variables using sensors and/or transducers.
CO-02	Perform specified control functions using a Programmable Logic Controller (PLC) and list various applications of embedded systems.
CO-03	Design and test an automation system for a required operational specification and troubleshoot to resolve any given issue(s).
CO-04	Explain the concepts of SCADA, HMI and DCS and list their various applications

3. Course Content

Week	CO	PO*	Lecture (Knowledge)	Tutorial (Activity)	Practice (Skill)
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	01	01	Introduction:	Ref Table 1	Study the following appliances/ automation

			<p>1. Need and benefits of Industrial Automation, Automation Hierarchy, Basic components of automation system, description of each component</p> <p>2. Automation technology as a part of engineering sciences, Key development milestones in the history of automation technology, Effects of automation on people.</p> <p>3. Types of automation system:- Relay logic and PLC</p>		<p>systems and identify various elements used and their function</p> <p>1. Air conditioning System 2. Automatic water level control 3. Elevator(for Three Floor) 4. Washing Machine</p> <p>Write the Block Diagram For each and explain with a Multimedia Presentation</p>
2	01	01	<p>Programmable logic controller:</p> <p>1. Introduction, Compare Relay Logic Control and PLC Logic Control, Internal Architecture of PLC</p> <p>2. I/O Modules (Interfaces), Memory organization.</p> <p>Input devices:</p> <ul style="list-style-type: none"> • Mechanical Switches • Proximity Switches <p>3. Input devices:</p> <ul style="list-style-type: none"> • Photo electric Sensors and Switches • Encoders • Temperature Sensors • Position/Displacement Sensors 	Ref Table 1	<p>Demonstrate the working of below shown Switches/Sensor.</p> <p>a. Various industrial Switches (Push Button, ON/OFF, Toggle, Emergency, Rotary Switches etc.) b. Proximity- Inductive, Capacitive and Optical Sensor c. Temperature Sensor d. Float Sensors</p> <p>Note: Connect each sensor directly to the LED/Lamp with appropriate power supply</p>
3	01	01	<p>1. Input devices:</p> <ul style="list-style-type: none"> • Strain Gauges • Pressure Sensors • Liquid level detectors <p>2. Input devices:</p> <ul style="list-style-type: none"> • Fluid flow measurement • Smart Sensors <p>3. Output Devices:</p> <ul style="list-style-type: none"> • Relay • Directional control Valve 	Ref Table 1	You tube presentation on Input and Output devices

4	01	01	<p>1. ADC and DAC</p> <p>2. Motors- DC motor, Synchronous motor, Servo motor,</p> <p>3. Induction motor, Stepper motor</p>	Ref Table1	<p>Demonstrate the Forward and Reversal of Stepper, Servo and DC Motors with the help of Drivers.</p> <p>Note: Demonstrate the above without using any controllers</p>
5	02	02	<p>PLC Programming:</p> <p>1. Programming standards, List Different PLC Programming, Ladder diagram,</p> <p>2. Standard IEC 1131-3 Symbols used for I/O Devices</p> <p>3. Ladder diagram for logic gates. AND,OR,NOT,NAND,NOR,XOR, XNOR</p>	Ref Table1	<ul style="list-style-type: none"> Execute energized motor or bulb using Switches in series or Parallel Write ladder diagram to test digital logic gates and Execute/Simulate the same.
6	02	01	<p>1. Writing Equivalent ladder diagram for Electric Switch, Belt drive , motor circuit Latching, Sequential O/P</p> <p>2. Introduction to Timer functions. Applications of timing functions in process control -- On Delay Timer Function, Off-delay Timer Function</p>	Ref Table 1	<ul style="list-style-type: none"> There are 3 mixing devices on a processing line A,B ,C. After the process begin mixer-A is to start after 7 seconds elapse, next mixer-B is to start 3.6 second after A. Mixer-C is to start 5 seconds after B. All of them remain ON until a master enable switch is turned off. Develop PLC ladder diagram, timing diagram and simulate the same Write a Ladder Program to count the number of Items moving

			3. PLC counter functions, Applications of PLC counter function in process control		on a conveyor Belt and Execute/Simulate the same
7	03	02	<p>1) Relay, Jumps and Subroutines</p> <p>2) Develop Ladder Program for relay based motor control automation such that the motor reverses its direction when the limit switches are activated</p> <p>3) Develop a PLC ladder diagram to construct an alarm system which operates as follows.</p> <ul style="list-style-type: none"> - If one input is ON nothing happens. - If any two inputs are ON, a red light goes ON. - If any three inputs are ON, an alarm sirens sound. - If all are ON, the fire department is notified. 	Ref Table 1	<ul style="list-style-type: none"> • Execute the Ladder Program for relay based motor control automation such that the motor reverses its direction when the limit switches are activated and also Demonstrate by interfacing with PLC • Simulate the PLC ladder diagram developed for an alarm system and also Demonstrate by interfacing with PLC
8	03	02	<p>1 & 2) Develop PLC program for the following application</p> <p>a) Traffic Light</p> <p>3) Develop PLC program for the following application</p> <p>b) Water Level Indicator</p>	Ref Table 1	<p>Execute a PLC program for the following applications</p> <p>i) Traffic light controlling</p> <p>ii) Water level controlling</p>
9	03	02	<p>1 & 2) Develop automatic door system using optical sensor and linear actuator</p> <p>3) Develop Automatic Elevator control</p>	Ref Table 1	<ul style="list-style-type: none"> • Execute automatic door system using optical sensor and linear actuator • Design ladder diagram for an Automatic Elevator control <p>Also, Test and simulate the ladder diagram designed to operate and control the</p>

					Automatic control	Elevator
10	03	02	1 & 2) Design ladder diagram for car parking. (Hint: car is to be detected and enter the parking space to a particular location if space is available. If there is no space, a lamp should indicate that parking is full) 3) Design ladder diagram for operating and controlling the Lift.	Ref Table 1	<ul style="list-style-type: none"> Simulate a ladder diagram for car parking. Test and simulate a ladder diagram designed to operate and control the Lift 	
11	02	02,07	1) Embedded System- Block Diagram of Embedded System 2) Applications of Embedded System <ul style="list-style-type: none"> Robotics Drones Braking System Air conditioning, Refrigerator Engine control System, 3) Applications of Embedded System <ul style="list-style-type: none"> Automatic Washing machine Microwave Oven Keyless entry in Automobiles. 		You tube Presentation on Applications of Embedded System	
12	04	01,07	1) Concepts on Distributed control System, 2) Concepts on HMI 3) Introductions to SCADA	Study the latest technological changes in this course and present the impact of these changes on industry	<ul style="list-style-type: none"> Multi media Exposure to DCS system Demonstrate the HMI interface to control Light in AND/OR Logic 	
13	04	01,07	1) Typical SCADA block diagram, 2) Benefits of SCADA, 3) Applications of SCADA	Study the latest technological changes in this course and present the impact of these changes on industry	<ul style="list-style-type: none"> Multi media Exposure to SCADA system OR Make case study visiting any nearby industry (Packaging/Milk Dairy/Processing) using HMI, SCADA/DCS systems. 	

Total in hours	39	13	52
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- *PO= Program Outcome as listed and defined in year 1 curriculum
- Course Co-Ordinator must prepare PO – CO mapping with strength (Low/Medium/High) before course planning

Table 1: Suggestive Activities for Tutorials: (The List is only shared as an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic and on the availability of such resources at their institution)

Sl.No.	Suggestive Activities for Tutorials
01	Write a PLC Ladder Program to Switching on/off the Lamp whether they are at the bottom or the top of the staircase.
02	The production line may be powered off accidentally or turned off for noon break. The program is to control the counter to retain the counted number and resume counting after the power is turned ON again. When the daily production reaches 500, the target completed indicator will be ON to remind the operator for keeping a record. Press the Clear button to clear the history records. The counter will start counting from 0 again. Write a PLC Ladder Program to perform this operation.
03	Write a PLC Ladder Program Providing lubricant for the gear box before the lathe spindle starts to run which aims to ensure that the oil pump motor starts first and the main motor starts subsequently.
04	Write a PLC Ladder Program such that Once the photoelectric sensor detects 10 products, the robotic arm will begin to pack up. When the action is completed, the robotic arm and the counter will be reset.
05	Develop PLC Programming Examples on Industrial Automation according to the logic given below, <ul style="list-style-type: none"> • A Saw, Fan and oil pump all go ON when a start button is pressed. • If the saw has operated less than 20s, the oil pump should go off when the saw is turned off and the fan is to run for an additional 5s after the shutdown of the saw. • If the saw has operated for more than 20s, the fan should remain on until reset by a separate fan reset button and the oil pump should remain on for an additional 10 s after the saw is turned off.
06	Develop and Simulate a PLC Ladder Diagram for Bottle Filling Plant
07	Study and present a Report on home Automation
08	Study and present a Report on Embedded systems in Automation
09	Study and present a Report on Automation in Processing Industries

4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3	CIE-3 Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill test reduced to 20
5	CIE-5 Skill Test-Practice	12	180	100	

6	CIE-6 Portfolio continuous evaluation of Tutorial sessions through Rubrics	1-13		10	10
			Total CIE Marks	60	
	Semester End Examination (Practice)	180	100	40	
			Total Marks	100	

5. Format for CIE written Test

Course Name	Elements of Automation	Test	I/II/III	Sem	IV
Course Code	20ME44P	Duration	80 Min	Marks	30
Note: Answer any one full question from each section. Each full question carries 10 marks.					
Section	Assessment Questions		Cognitive Levels(R/U/A)	Course Outcome	Marks
I	1				
	2				
II	3				
	4				
III	5				
	6				

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.

5.(a)For CIE Skill Test -4

Duration :240 Min

SL. No.	CO	Particulars/Dimension	Marks
1	02	Select a suitable Sensor / Switch for a given Process Variable and activate <ul style="list-style-type: none"> • Selection of Sensor/Transducer – 05Marks • Activation and Result – 15 Marks 	20
2	02	Select a suitable motor for the given case and energize <ul style="list-style-type: none"> • Selection of the Motor – 10 Marks • Energize and Result – 20 Marks 	30
3	03	Develop and Simulate a simple ladder diagram for a given Case <ul style="list-style-type: none"> • Writing Ladder Program – 20 Marks • Simulate and Troubleshoot - 20 Marks 	40
4	01,02,03	Portfolio evaluation based on the average of all Practice Sessions (1 -6 Weeks)	10
Total Marks			100

5 . (b) For CIE Skill Test -5

Duration: 240 Min

SL. No.	CO	Particulars/Dimension	Marks
1	03	Device and Simulate a ladder diagram for the given Case Study (PLC Based) <ul style="list-style-type: none"> • Writing Ladder Program – 40 Marks • Simulate and Troubleshoot - 20 Marks 	60
2	04	Prepare a SCADA Block Diagram for the given Case	30
3	03,04	Portfolio evaluation based on the average of all Practice Sessions (7-12 Weeks)	10
Total Marks			100

6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
		Average Marks= (8+6+2+2)/4=4.5					5

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

7. Reference :

Sl. No.	Description
1	Programmable logic Controllers By W. BOLTON
2	Digital electronics By FLYOD
3	Exploring PLC with applications By PRADEEP KUMAR SRIVATSAVA
4	Automation , Production systems and Computer integrated Manufacturing By MIKELL GROOVER
5	Sensors Hand book-SABRIE SOLOMAN-MC-GRAW HILL publications
6	Hand book of Modern Sensors" Physics ,Designs and Applications- JACOB FRADEN-Springer Publications
7	Electric Motors and Drives BY AUSTIN HUGHES and BILL DRURY

8. LIST OF SOFTWARE/LEARNING WEBSITES

- 1.<http://www.vlab.com>
- 2.<http://www.mtabindia.com>
- 3.<http://www.nptel.ac.in>

9. SEE Scheme of Evaluation

Duration :180 Min

SL. No.	CO	Particulars/Dimension	Marks
1	02	Select a suitable Sensor / Switch for a given Process Variable and activate <ul style="list-style-type: none"> • Selection of Sensor/Transducer – 10 Marks • Activation and Result – 20Marks OR Select a suitable motor for the given case and energize <ul style="list-style-type: none"> • Selection of the Motor – 10 Marks • Energize and Result – 20 Marks 	30
3	03	Device and Simulate a ladder diagram for the given Case Study <ul style="list-style-type: none"> • Writing Ladder Program –30 Marks • Simulate and Troubleshoot –20 Marks 	50
4	01,02, 03,04	Viva voce	20
Total Marks			100

10. Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
01	PLC Trainer Kit with the following Modules		05 No

	<ul style="list-style-type: none"> • Door Controller • Car Parking Application • Water Level Controller • Conveyor Controller Application • Lift control Application <p>With different Length Patch Cords</p>		
02	<p>Switches</p> <ul style="list-style-type: none"> • Mechanical Switches • Proximity Switches • Photo electric Sensors and Switches 		05 No each
03	<p>Sensors</p> <ul style="list-style-type: none"> • Temperature Sensors • Position/Displacement Sensors • Strain Gauges • Pressure Sensors • Liquid level detectors • Fluid flow measurement • Smart Sensors • Proximity Sensors 		05 No each
04	Induction Motor with DOL Starter	3 Phase Ac 50 Hz	01
05	Synchronise Motor with DOL Starter	3 Phase Ac 50 Hz	01
06	Stepper Motor	Standard size	01
07	Relays	Standard size	10
08	Counter and Timers	Standard size	10



Government of Karnataka
Department of Collegiate and Technical Education

Programme	Audit Course	Semester	IV
Course Code	20ME45T	Type of Course	Audit
Course Name	Indian Constitution	Contact Hours	2 hours/week 26 hours/semester
Teaching Scheme	L:T:P :: 2:0:0	Credits	2
CIE Marks	50	SEE Marks	Nil

1. Course Outcomes: At the end of the Course, the student will be able to:

CO-01	CO1	Understand Preamble, salient features and importance of Indian Constitution.
CO-02	CO2	Understand Fundamental rights, duties and Directive principles of state policy.
CO-03	CO3	Understand Parliamentary system of governance, Structure, Functions, Power of Central, state governments (Legislative, Executive) and Judiciary.
CO-04	CO4	Understand Panchayat Raj Institutions and Local self-governments, UPSC, KPSC, NHRC, Status of women, RTE etc.

2. Course Content

Week	CO	Detailed Course Content	Contact Hours
1	1	Introduction to constitution of India-Formation and Composition of the Constituent Assembly-Salient features of the Constitution-Preamble to the Indian Constitution	2
2	1,2	Fundamental Rights- Definition, The right to equality, The right to freedom, The right against exploitation, The right to freedom of religion.	2
3	1,2	Cultural and educational rights and The right to constitutional remedies. Fundamental Duties, Directive principles of state policy.	2
4	1,3	Parliamentary system of governance- Structure of Parliament- Lok Sabha and Rajya Sabha. Functions of parliament- Legislative, Executive, Financial Function Powers of Lok Sabha and Rajya Sabha.	2
5	1,3	Procedure followed in parliament in making law, Annual financial statement (Budget) – procedure in parliament with respect to estimates, Appropriation bill, Supplementary, additional grants, Vote on account, votes on credit and exception grant, special provisions, rules of procedure.	2
6	1,3	Structure of union executive, Power and position of President. Vice President, Prime minister and council of ministers.	2
7	1,3	Structure of the judiciary: Jurisdiction and functions of Supreme Court, high court, and subordinate courts.	2
8	1,3	Federalism in the Indian constitution- Division of Powers: Union list, State list and concurrent list. Structure of state legislation, Legislative assembly and Legislative council.	2
9	1,3	Functions of state legislature, Structure of state executive-Powers and positions of Governor, Speaker, Deputy Speaker, Chief Minister and council of minister.	2
10	4	Local self-government- meaning-Three tier system, Village Panchayat-Taluk panchayat Zilla panchayat, Local bodies-Municipalities and Corporations, Bruhat Mahanagara Palike, Functions of Election commission, UPSC, KPSC.	2

11	4	Amendment of the constitution, Human Rights-Definition-constitutional provisions-right to life and liberty-Human Rights of Women-Discrimination against women steps that are to be taken to eliminate discrimination against women in Education, employment, health care, Economic and social life,	2
12	4	Status of Women in India - Women in rural areas, Constitutional Safeguards - Dowry Prohibition act 1961- Domestic violence act 2005- Sexual harassment at work place bill 2006. Human Rights of Children- Who is a child- list the Rights of the Child- Right to education, Protection of Children from Sexual Offences Act (POCSO)-2012-	2
13	1,4	National Human Rights Commission Constitution- Powers and function of the Commission-Employee rights- Provisions made, Contractual-Non contractual employee rights-Whistle blowing-definition-Aspects-Intellectual Property Rights (IPR)-Meaning-Need for protection- Briefly description of concept of patents, Copy right, Trademark	2
Total in Hours			26 Hrs

REFERENCES

1. Introduction to the Constitution of India- Dr. Durga Das Basu
2. Empowerment of rural women in India-Hemalatha H.M and Rameshwari Varma, Hema Prakashana.

4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3	CIE-3 Written Test	13	80	30	
4.	CIE-4 MCQ	6	60	20	Average of two CIE = 20
5	CIE-5 Open Book Test	12	60	20	
Total CIE Marks					50
Semester End Examination (Practice)			-	-	-
Total Marks					50