DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

Scheme of Teaching and Evaluation

(Students admitted to the First year in the Academic Year 2021 - 2022)

V Semester BE

Sl. No	Subject Code	Subject Title	Credits	HOURS/ WEEK			EXAMINATION MARKS		
				L	T	P	CIE	SEE	Total
1	21UIP501C	Introduction to Industry 4.0	03	3	0	0	50	50	100
2	21UIP502C	Operations Research	03	3	0	0	50	50	100
3	21UIP503C	Digital Design and Manufacturing	03	3	0	0	50	50	100
4	21UIP505N	Open Elective - I	03	3	0	0	50	50	100
5	21UIP504E	Professional Elective Course - I	03	3	0	0	50	50	100
6	21UHSXXX	Soft Skill	02	2	0	0	--	--	--
7	21UIP506L	Digital Design and Manufacturing Laboratory	01	0	0	2	50	50	100
8	21UIP507I	Summer Internship - II	02	0	0	4	50	50	100
9	21XXXXXX	Environmental Studies	01	2	0	0	50	50	100
		Total	21	19	0	06	400	400	800

21UIP501C	INTRODUCTION TO INDUSTRY 4.0	Credits: 03
L : T : P - 3 : 0 : 0		CIE Marks: 50
Total Hours / Week: 03		SEE Marks: 50

UNIT - I	10 Hrs.

Introduction to Industry 4.0: The Various Industrial Revolutions, Digitalisation and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0, The Journey so far: Developments in USA, Europe, China and other countries, Comparison of Industry 4.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.

UNIT - II	10 Hrs.

Road to Industry 4.0: Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, Smart Manufacturing, Smart Devices and Products, Smart Logistics, Smart Cities, Predictive Analytics.

UNIT - III	10 Hrs.

Related Disciplines, System, and Technologies for enabling Industry 4.0: Cyber physical Systems, Robotic Automation and Collaborative Robots, Support System for Industry 4.0, Mobile Computing, Related Disciplines, Cyber Security.

UNIT - IV	10 Hrs.

Role of data, information, knowledge and collaboration in future organizations: Resource based view of a firm, Data as a new resource for organizations, Harnessing and sharing knowledge in organizations, Cloud Computing Basics, Cloud Computing and Industry 4.0.

Reference Books *

1. Artificial Intelligence a Modern Approach by Peter Norvig, Rusell.
2. Internet of Things - A hands on approach, Arshdeep Bahga and Vijay Madisetti.
3. Architecting for the Cloud - AWS Best Practices.
4. A Roadmap to Industry 4.0: Smart Production, Sharp Business and Sustainable Development, by Anand Nayyar and Akshi Kumar Editors, Springer Nature Switzerland AG 2020, ISBN 978-3-030-14543-9 ISBN 978-3-030-14544-6 (eBook).
5. Industry 4.0 Developments towards the Fourth Industrial Revolution, by Kaushik Kumar, Divya Zindani, J. Paulo Davim, SPRINGER BRIEFS IN APPLIED SCIENCES AND TECHNOLOGY, ISBN 978-981-13-8164-5 ISBN 978-981-13-8165-2 (eBook).
6. Industry 4.0 and Engineering for a Sustainable Future, Mohammad Dastbaz and Peter Cochrane (Editors), Springer Nature Switzerland AG 2019, ISBN 978-3-030-12952-1 ISBN 978-3-030-12953-8 (eBook).

Course Outcomes**
1. Recognize the drivers and enablers of Industry 4.0. 2. Understand the smartness in Smart Factories, Smart cities, smart products and smart services. 3. Comprehend the framework of various systems used in a manufacturing plant and their role in an Industry 4.0 world. 4. Gian insights into the power of Cloud Computing in a networked economy.

*** Books to be listed as per the format with decreasing level of coverage of syllabus**

**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3					2	2	2	2						
CO2		2										1			
CO3				2	2	2			2						
CO4					2	2		2							
CO5	3					2	2	2	2						
CO6		2										1			

21UIP502C	OPERATIONS RESEARCH	Credits: 03
L:T:P - 3: 0: 0		CIE Marks: 50
Total Hours / Week: 03		SEE Marks: 50

UNIT - I	13 Hrs.

Introduction - Definition of operation research, application of OR to engineering and managerial problems, features of OR models, limitations of OR and models of OR.

Linear programming (LP) - Definition, mathematical formulation of LP problems, standard form, Matrix form of LPP, solution-feasible, basic feasible, optimal, infeasible, multiple, optimal, redundancy, degeneracy. Graphical method, simplex method, variants of simplex algorithm-artificial basis techniques.

UNIT - II	13 Hrs.

Transportation problem (TP) - Formulation of transportation model, Basic feasible solution using different methods (North-West corner, Least Cost, Vogel's Approximation Method) Optimality Methods. Unbalanced transportation problem, Degeneracy in transportation problems. **Assignment problem (AP) -** Formulation of the assignment problem, unbalanced assignment problem, difference between TP and AP, traveling sales man problem.

UNIT - III	13 Hrs.

Project management-using network analysis - Introduction, **Critical Path Method (CPM) -** Rules for Network construction, determination of critical path and duration, floats, Time Analysis - ES, EF, LS, LF and types floats. **Programme Evaluation and Review Technique (PERT) -** Estimation of project duration and variance.

UNIT - IV	13 Hrs.

Replacement analysis - Introduction, reasons for replacement, Individual replacement of Machinery or equipment with / without value of money, group replacement policies, problems. **Game theory -** Introduction, Pay-off, Types of games, The Maximin - Minimax principles Formulations of games, two-person zero sum game, games with and without saddle point, Graphical solutions (2xn,mx2game) and dominance property.

Assignments - Students have to submit their assignments using OR software packages

Reference Books *

1. Operation Research and Introduction - Taha H A, Prentice Hall of India, 6th edition, 1999.ISBN-81-203-1222-8.
2. Principles of Operations Research- Philips, Ravindram and Soleberg - Theory and Practice, PHI, 2nd Edition, 2007.ISBN:978-81-265-1256-0.
3. Introduction to Operation Research- Hiller and Libermann, McGraw Hill 6th edn., 2009.ISBN-13:978-0-7-060092-8.
4. Operations Research, S.D. Sharma, Kedarnath, Ramnath & Co, 6TH EDN.2009.ISBN-978-81-907011-0-5.
5. Operations Research Theory and Application- J K Sharma, Pearson Education Pvt Ltd , 4thEdn, ISBN-10:0230-63885-6.
6. Operations Research - Kanthi Swarup & others, Sultan Chand and Sons. 1992.14th Edn., 2009.ISBN978-81-8854-719-5.

Course Outcomes**
After completion of the course student will be able to: 1. To have the knowledge of role of O.R. in solving industrial problems. 2. Formulate and solve mathematical model (linear programming problem) for a physical situations like production, distribution of goods and economics.) 3. Realize variety of problems such as assignment, transportation, travelling salesman etc 4. Identify the resources required for a project and generate a plan and use CPM and PERT techniques, to plan, schedule, and control project activities. 5. Analyze variety of replacement situations and Game theory 6. Apply software tools to obtain optimal solutions from a mathematical model.

*** Books to be listed as per the format with decreasing level of coverage of syllabus**

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Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3		3		1	1				1	1	2	2	3	2
CO2	2	3	2			1			3	1	2	2	2	2	2
CO3	2	3	2	3				1	2		2	2	2	2	
CO4	2			1	1	2			2		2		2	2	2
CO5	2	2	2	2	2		1		2		3	2	2	2	2
CO6	3	3	2	2	2	1				1	2		2	2	

21UIP503C	DIGITAL DESIGN AND MANUFACTURING	Credits: 03
L : T : P - 3: 0 : 0		CIE Marks: 50
Total Hours / Week : 03		SEE Marks: 50

UNIT - I	13 Hrs.
Digital Manufacturing: Development Course of Manufacturing and Manufacturing Science, Definition of Digital Manufacturing, Features and Development of Digital Manufacturing. **Architecture of Digital Manufacturing System:** Basic Architecture Model of Digital Manufacturing System, The Definition of Digital Manufacturing System, Organization Model of Digital Manufacturing System, Function Model of Digital Manufacturing System, Information Model of Digital Manufacturing System, Operation and Control Model of Digital Manufacturing System. **CAD Modeling**: Design process and role of CAD, Types and applications of design models, Three dimensional modeling schemes, Wire frames and surface representation schemes, Solid modeling - Parametric modeling, Assembly modeling.	
UNIT- II	**13 Hrs.**
CAD/CAM: Computers in industrial manufacturing, Design process, Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), Advantages and disadvantages CAD and CAM. **Computer control in NC:** Introduction and basic components of an NC system, NC procedure, NC co- ordinate systems, NC motion control systems, applications of Numerical control and Economics of numerical control Introduction, problems with conventional NC, NC controller technology, CNC, DNC, combined CNC and DNC systems. **CNC Programming:** Part programming fundamentals, Manual part programming methods, Preparatory functions (G), Miscellaneous functions (M), Program number, Tool length compensation, Canned cycle, Cutter radius. compensation, milling and Drilling programming problems.	
UNIT- III	**13 Hrs.**
Reverse Engineering: Introduction to Reverse Engineering, Basic Theory of Reverse Engineering, Application of Reverse Engineering in Digital Manufacturing, Applications of 3D Scanner. **Digital factory and virtual manufacturing:** Introduction, Scope, Methods and Tools Used in Virtual Manufacturing, Benefits. Virtual factory simulation. **Product life cycle management**: Introduction, PLM softwares, Outsourcing chain, PLM and Concurrent Engineering, other advantages of PLM, components of PLM software.	
UNIT-IV	**13 Hrs.**
Internet of Things: Introduction, Applications, IoT data management requirements, Architecture of IoT, Technological challenges, Issues in implementing IoT. **Additive Manufacturing:** Introduction to Additive manufacturing (AM), The Generic AM Process, Why use the term Additive manufacturing? The Benefits of AM, Distinction between AM and CNC machining, Development of AM Technology, Classification of AM Processes.	

Reference Books *

1. Ian Gibson, David W. Rosen, and Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer New York, 2010, ISBN: 978-1-4419-1119-3 e-ISBN: 978-1-4419-1120-9, DOI 10.1007/978-1-4419-1120-9.
2. Zude Zhou, Shane (Shengquan) Xie, Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer, 1012, ISBN 978-0-85729-563-7 e-ISBN 978-0-85729-564-4, DOI 10.1007/978-0-85729-564-4.
3. P. Radhakrishnan, S. Subramanian, V. Raju, CAD/CAM/CIM, 3rd Ed. 2008, New Age International (P) Ltd., ISBN (13) : 978-81-224-2711-0.
4. P.N. Rao, CAD / CAM Principles and Applications, TMH, New Delhi, 3rd Edition, 2002.
5. Ibrahim Zeid, CAD/CAM theory and practice. McGraw-Hill Higher Education, 1991.
6. Mikell P-groover, Emory W. Zimrners, CAD/CAM, Jr Pearson Education inc, 2003.

Course Outcomes**

1. Students will understand the concept, applications, architecture of digital manufacturing and the use of Computer Aided Design modeling that aids in the digital manufacturing.
2. The students will be able to write and execute CNC part programmes understanding the difference between traditional, NC, CNC & DNC machining concepts, economic aspects and motion control systems.
3. Students will be introduced to the concept and application of reverse engineering, 3D scanner/printer, digital/virtual manufacturing and the components & software used in Product Life Cycle Management.
4. Students will be exposed to the emerging areas such as Internet of Things and additive manufacturing and will understand challenges, issues and benefits of the two.
5. Students will understand the concept, applications, architecture of digital manufacturing and the use of Computer Aided Design modeling that aids in the digital manufacturing.

*** Books to be listed as per the format with decreasing level of coverage of syllabus**

**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes(POs)												Program Specific Outcomes(PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1		1								1		1
CO2	3	3	3	3	3	2			2	2	1		2	3	2
CO3	3	2	1	2	3	2	2		1	2	2	1	2	2	2
CO4	3	2		2	3	2	2		3	2	2	2	2	2	3
CO5	3	1	1		1								1		1

21UIP506L	DIGITAL MANUFACTURING LABORATORY	Credits: 01
L : T : P - 0 : 0 : 2		CIE Marks: 50
Total Hours / Week: 02		SEE Marks: 50

PART A	10 Hrs.
1. Writing and execution of manual programmes using ISO codes for machining of simple part in a. Turning(2exercises) b. Taper turning(2exercises) 2. Simplepartprogrammesandexecutionusingtoolradiuscompensationandcannedcycles (4Exercises)	
PART B	**10 Hrs.**
1. Writing and execution of simple milling part programmes, with radius compensation and a. Curved cycles(4exercises) 2. Manual programming of the robot for pick and place operations (2exercises)	
PART C	**10 Hrs.**
1. Design, modeling and printing (additive manufacturing) of 3Dobjects and parts (DEMO) 2. Studyon3DScanner **3.** Simulation of Virtual real factory	

Reference Books *

1. P.N. Rao, 2002,CAD/CAM Principles and Applications-,TMH, New Delhi.
2. Appu Kuttan K.K, Robotics, IK International Publishing House Private Limited.
3. N.Hopkinson,R.J.M.HagueandP.M.Dickens,2006, Editors, Rapid Manufacturing: An IndustrialRevolutionfortheDigitalAge,JohnWileyandSons,Ltd,ISBN-13978-0-470-01613-8.

Course Outcomes**

1. Apply the techniques of CNC programming and cutting tool path generation through CNC simulation software by using G-codes and M-codes and writing part program for simple machine parts for turning and milling operations.
2. Investigate the workflow of digital manufacturing: from scanning to modeling to printing.
3. Apply the principles of reverse engineering and 3D scanning to the digital manufacturing workflow.
4. Gain Hands on experience using CNC lathe, milling machines and robot.

*** Books to be listed as per the format with decreasing level of coverage of syllabus**

**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2	1				1			1	2	2	2
CO2	3	2	3	2	2				1			1	3	2	3
CO3	3	2	3	2	1				1			1	3	2	2
CO4	3	2	2	2	1				1			1	2	2	2

21UIP507I	SUMMER INTERNSHIP - II	Credits: **02**
L : T : P - 0 : 0 : 4		CIE Marks: 50
Total Hours / Week: 04		SEE Marks: 50

The students have to undertake 6 weeks of Internship at a reputed industry after 6th semester.
The main objective of this internship is to provide practical exposure to students regarding the Industry.

2) Assessment Rubrics for Internships and Technical Seminars, Mini-Project, Major Project Phase I&II of BE program

2.1 Internship

2.1.1 Internship Guidelines

- Step 1: Request Letter/ Email from the office of Training & Placement cell of the college should go to industry to allot various slots of 4-6 weeks during summer vacation.
- Step 2: Industry will confirm the training slots and the number of seats allocated for internships via Confirmation Letter/ Email.
- Step 3: Students on joining Training at the concerned Industry / Organization, submit the Joining Report/ Letters / Email.
- Step 4: Students undergo industrial training at the concerned Industry / Organization.
- Step 5: Students will submit training report after completion of internship.
- Step 6: Training Certificate to be obtained from industry.
- Step 7: List of students who have completed their internship successfully will be issued by Training and Placement Cell.

2.1.2 Internship Report

2.1.2.1 Student's Diary/ DailyLog

Student's Diary and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training. It will be evaluated on the basis of the following criteria:

- Regularity in maintenance of thediary.
- Adequacy & quality of information recorded.
- Drawings, sketches and datarecorded.
- Thought process and recording techniques used.
- Organization of the information.

2.1.2.2 Internship Report

The Internship report will be evaluated on the basis of following criteria:

- Originality.
- Adequacy and purposeful write-up.
- Organization, format, drawings, sketches, style, language etc.
- Variety and relevance of learning experience.
- Practical applications, relationships with basic theory and concepts taught in the course

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The industrial training of the students will be evaluated in three stages:

1. Evaluation by Industry.
2. Evaluation through seminar presentation and
3. Viva-voce at the Institute.

2.1.3 Evaluation Through Seminar Presentation/Viva-Voce at The Institute

The student will give a seminar based on his training report, before an expert committee constituted by the concerned departmentaspernormsoftheinstitute.Theevaluationwillbebasedonthefollowingcriteria:

- Quality of content presented.
- Proper planning for presentation.
- Effectiveness of presentation.
- Depth of knowledge and skills.
- Attendance record, daily diary, departmental reports shall also be analyzed along with the Internship Report.

Evaluation of Internship – Grading Rubric(Industry)

Evaluation dimensions	Performance rating			Maximum score
	Needs improvement	Meets expectations	Excellent	
	0 - 4	5 - 7	8 - 10	
Internship evaluation dimensions - Grading criteria				
Quality of work	Work was done in a careless manner and was of erratic quality; Work assignments were usually late and required review; Made numerous errors	With a few minor exceptions, adequately performed most work requirements; Most work assignments submitted in a timely manner; Made occasional errors	Thoroughly and accurately performed all work requirements; Submitted all work assignments on time; Made few if any errors	10
Ability to learn	Asked few questions and rarely sought out additional information Unable or slow to understand new concepts, ideas, and work assignments; Unable or unwilling to recognize mistakes and was not receptive to making needed changes and improvements	Asked relevant questions and sought out additional information from appropriate sources; Acceptable understanding of new concepts, ideas, and work assignments; Willing to take responsibility for mistakes and to make needed changes and improvements	Consistently asked relevant questions and sought out additional information from appropriate sources; Quickly understood new concepts, ideas, and work assignments; Always willing to take responsibility for mistakes and to make needed changes and improvements	10
Initiative and creativity	Had little observable drive and required close supervision; Showed little interest in meeting standards; Did not seek out additional work and frequently procrastinated in completing assignments; suggested no new ideas or options	Worked without extensive supervision; Found problems to solve and sometimes asked for additional work assignments; Set his/her own goals and, tried to exceed requirements; offered some creative ideas	A self-starter; Consistently sought new challenges and asked for additional work assignments; Regularly approached and solved problems independently; Frequently proposed innovative and creative ideas, solutions, and/or options	10
	0 - 1	2 - 3	4 - 5	
Character traits	Regularly exhibited a negative attitude; Dishonest and/or showed a lack of integrity on several occasions; Unable to recognize and/or was insensitive to ethical and diversity issues; Displayed significant lapses in ethical and professional behavior	Except in a few minor instances, demonstrated a positive attitude; Regularly exhibited honesty and integrity in the workplace; Usually aware of and sensitive to ethical and diversity issues on the job; Normally behaved in an ethical and professional manner	Exceptionally positive attitude; Consistently exhibited honesty and integrity in the workplace; Keenly aware of and deeply sensitive to ethical and diversity issues on the job; Always behaved in an ethical and professional manner	5

Evaluation dimensions	Performance rating			Maximum score
	Needs improvement	Meets expectations	Excellent	
	0 - 1	2 - 3	4 - 6	
Internship evaluation dimensions - Grading criteria				
Dependability	Generally unreliable in completing work assignments; Did not follow instructions and procedures promptly or accurately; Careless, and work needed constant follow-up; required close supervision	Generally reliable in completing tasks; Normally followed instructions and procedures; Usually attentive to detail, but work had to be reviewed occasionally; Functioned with only moderate supervision	Consistently reliable in completing work assignments; Always followed instructions and procedures well; Carefuland extremely attentive to detail; Required little or minimum supervision	5
Organizational Fit	Unwilling or unable to understand and support the organization's mission, vision, and goals; Exhibited difficulty in adapting to organizational norms, expectations, and culture; Frequently seemed to disregard appropriate authority and decision- making channels	Adequately understood and supported the organization's mission, vision, and goals; Satisfactorily adapted to organizational norms, expectations, and culture; Generally functioned within appropriate authority and decision-making channels	Completely understood and fully supported the organization's mission, vision, and goals; Readily and successfully adapted to organizational norms, expectations, and culture; Consistently functioned within appropriate authority and decision- making channels	5
Response to Supervision	Rarely sought supervision when necessary; Unwilling to accept constructive criticism and advice; Seldom implemented supervisor suggestions; Unwilling to explore personal strengths and areas for improvement	Sought supervision when necessary; Receptive to constructive criticism and advice; Implemented supervisor suggestions in most cases; Willing to explore personal strengths and areas for improvement	Actively sought supervision when necessary; Always receptive to constructive criticism and advice; Successfully implemented supervisor suggestions when offered; Always willing to explore personal strengths and areas for improvement	5

Evaluation of internship - Grading rubric (Department evaluation committee / faculty)				
Evaluation dimensions	Performance Rating			Maximum Score
	Needs improvement	Meets expectations	Excellent	50
	0 - 8	9 - 14	15 - 20	
Internship Evaluation Dimensions – Grading Criteria				
Demonstration of experience	Offers little in the way of illustrating experiences Fails to adequately address how the experiences relate to the competencies.	Addresses the Activities and experiences, but not so clearly and concisely	Well addressed activities and experiences as well as relating them to the program competencies.	20
Report	Unedited and difficult to read It is littered with grammatical and typographical errors, demonstrating little effort to producing a quality report. No reference is made to practical application. Lacks evidence and internship experience	Well-written for the most part but still has somewhat detracting errors that could have been fixed with additional editing prior to submission. Key concepts related to the selected evidence and internship experience are inaccurate or incomplete. Some helpful practical applications are included.	Has been carefully edited and is free or nearly free of any grammatical ortypographical errors. Well-organized report is easy to read and understand and stands alone as a quality piece of writing. An accurate and complete reflection of key concepts related to the selected evidence and internship experience Practical applications are included to illuminate issues.	20
	0 - 4	5 - 7	8 - 10	10
Presentation	Information is lacking/unclear and communicated in such a way that the audience cannot understand the purpose of the evidence work and internship experiences.	Information is presented in a clear manner but still lacks practical experience	Information is communicated in a thorough manner and ideas are expressed in such a way that the audience can clearly understand the evidence work and internship experiences.	10

Summary of internship evaluation (Industry representative)	
Evaluation Criteria	**Score from the above tables**
Quality of Work	10
Ability to Learn	10
Initiative and Creativity	10
Character Traits	05
Dependability	05
Organizational Fit	05
Response to Supervision	05
	50
Internship Guide	
Demonstration of experience	20
Report	20
Presentation	10
	50
Total Score	**100**