VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations and Syllabus
M.Tech., Computer Integrated Manufacturing (MCM)
(Effective from the Academic year 2022-23)

Registrar,
Visvesvaraya Technological University
Jnana Sangam, Machhe, Belagavi-590018
eMail: registrar@vtu.ac.in
contact: 0831-2498112

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2022
M.Tech.,**Computer Integrated Manufacturing (MCM)**
Choice Based Credit System (CBCS) and Outcome-Based Education (OBE)

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical/Seminar	Tutorial/ Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1	BSC	22MCM/MTR11	Mathematical Methods in Engineering	03	00	00	03	50	50	100	3
2	IPCC	22MCM12	Industrial Robotics	03	02	00	03	50	50	100	4
3	PCC	22MCM13	Computer Integrated Manufacturing System	03	00	02	03	50	50	100	4
4	PCC	22MCM14	Control System Engineering	02	00	02	03	50	50	100	3
5	PCC	22MCM15	CNC Machines	02	00	02	03	50	50	100	3
6	MCC	22RMI16	Research Methodology and IPR	03	00	00	03	50	50	100	3
7	PCCL	22MCML17	Computer Integrated Manufacturing Laboratory(Lab-I)	01	02	00	03	50	50	100	2
8	AUD/AEC	22AUD18/ 22AEC18	BOS recommended ONLINE courses	Classes and evaluation procedures are as per the policy of the online course providers.							PP
			TOTAL	**17**	**04**	**06**	**21**	**350**	**350**	**700**	**22**

Note: BSC-Basic Science Courses, PCC: Professional core. IPCC-Integrated Professional Core Courses, MCC- Mandatory Credit Course, AUD/AEC –Audit Course / Ability Enhancement Course (A pass in AUD/AEC is mandatory for the award of the degree), PCCL-Professional Core Course lab, L-**Lecture, P-Practical, T/SDA-Tutorial / Skill Development Activities** (Hours are for Interaction between faculty and students)

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

Audit Courses /Ability Enhancement Courses Suggested by BOS (ONLINE courses): Audit Courses: These are prerequisite courses suggested by the concerned Board of Studies. Ability Enhancement Courses will be suggested by the BoS if prerequisite courses are not required for the programs. **Ability Enhancement Courses**:

- These courses are prescribed to help students to enhance their skills in in fields connected to the field of specialisation as well allied fields that leads to employable skills. Involving in learning such courses are impetus to lifelong learning.
- The courses under this category are online courses published in advance and approved by the concerned Board of Studies.
- Registration to Audit /Ability Enhancement Course shall be done in consultation with the mentor and is compulsory during the concerned semester.
- In case a candidate fails to appear for the proctored examination or fails to pass the selected online course, he/she can register and appear for the same course if offered during the next session or register for a new course offered during that session, in consultation with the mentor.
- The Audit Ability Enhancement Course carries no credit and is not counted for vertical progression. However, a pass in such a course is mandatory for the award of the degree.

Skill development activities: Under Skill development activities in a concerning course, the students should

1. Interact with industry (small, medium, and large).
2. Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits/ fieldwork.
4. Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc.

Students and the course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

Semester- I

MATHEMATICAL METHODS IN ENGINEERING
Common to MCM/MTR

Course Code	22MCM11	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

1. To have an insight into solving roots of equations.
2. Learn to use the roots of polynomial.
3. To learn system of linear algebraic equations.
4. To Learn concepts of linear transformation.

Module-1

Approximations and round off errors: Significant figures, accuracy and precision, error definitions, round off error and truncation errors. Mathematical modeling and Engineering problem solving: Simple mathematical model.
Roots of Equations: Bracketing methods-Graphical method, Bisection method, False position method, Newton-Raphson method, Secant Method. Multiple roots, Simple fixed point iteration. MATLAB or Sci Lab session for solving equations using Graphical method, Bisection method, False position method and Newton Raphson method.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Roots of Polynomial - Polynomials in Engineering and Science, Muller's method, Numerical Differentiation and Numerical Integration: Newton – Cotes and Gauss Quadrature Integration formulae, Integration of Equations, Romberg integration, Numerical Differentiation Applied to Engineering problems, High Accuracy differentiation formulae. MATLAB or Sci Lab session for Numerical differentiation and Numerical Integration**.**

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

System of Linear Algebraic Equations and Eigen Value Problems: Introduction, Direct methods, Cramer's Rule, Gauss Elimination Method, Gauss-Jordan Elimination Method, Triangularization method, Cholesky Method, Partition method, error Analysis for direct methods, Iteration Methods. MATLAB or Sci Lab session for solving system of equations using Cramer's Rule, Gauss elimination method and Gauss-Jordan method.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Eigen values and Eigen Vectors: Bounds on Eigen Values, Jacobi method for symmetric matrices, Givens method for symmetric matrices, Householder's method for symmetric matrices, Rutishauser method for arbitrary matrices, Power method, Inverse power method. MATLAB or Sci Lab session for find in Eigen values and Eigen vectors of a square matrix.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Linear Transformation: Introduction to Linear Transformation, The matrix of Linear Transformation, Linear Models in Science and Engineering. Orthogonality and Least Squares: Inner product, length and orthogonality, orthogonal sets. Model some simple mathematical models of physical Applications and Find the roots of polynomials in Science and Engineering problems.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

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Suggested Learning Resources:

Books

1. S.S. Sastry , Introductory Methods of Numerical Analysis, PHI, 2005.
2. Steven C. Chapra , Raymond P.Canale , Numerical Methods for Engineers ,Tata McgrawHill,4th Ed,2002.
3. M K Jain, S. R. K Iyengar, R K. Jain, Numerical methods for Scientific and engg computation, New Age International, 2003.
4. Pervez Moin, Fundamentals of Engineering Numerical Analysis, Cambridge,2010
5. David. C. Lay, Linear Algebra and its applications, 3rd edition, Pearson Education, 2002.

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- http://www.bookstreet.in.
- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Use the numerical methods for solving algebraic and transcendental equations which comes in mechanical engineering courses.	5
CO2	Demonstrate common numerical methods and how they are used to obtain approximate solutions.	5
CO3	Analyze and evaluate the accuracy of common numerical methods.	5
CO4	Apply modern tools numerical methods to solve problems.	4
CO5	Write efficient code and present numerical results in an informative way.	5

Program Outcome of this course

Sl. No.	Description	Pos
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	
PO8	Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	
PO9	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	
PO10	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**1**
CO2	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**2**
CO3	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**1**
CO4	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**1**
CO5	**2**	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**

INDUSTRIAL ROBOTICS			
Course Code	**22MCM12**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

1. The goal of the course is to familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, and incorporate robotic technology in engineering systems.
2. Make the students acquainted with the theoretical aspects of Robotics
3. Enable the students to acquire practical experience in the field of Robotics through design projects and case studies.
4. Make the students to understand the importance of robots in various fields of engineering.

MODULE-1

Introduction: Automation and Robotics – An over view of Robotics – present and future applications. Components of the Industrial Robotics: common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

08Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE-2

Motion Analysis: Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems. Manipulator Kinematics-H notation-H method of Assignment of frames-H Transformation Matrix, joint coordinates and world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulators.

08Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE-3

Differential transformation of manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion straight line motion.

08Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE-4

Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors – End Effectors and Tools

08Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE 5

Robot Application in Manufacturing: Material Transfer – Material handling, loading and unloading- Processing – spot and continuous arc welding & spray painting – Assembly and Inspection. Robotic Programming Methods – Languages: Lead Through Programming, Textual Robotic Languages such as APT, MCL.

08Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

Sl.NO	Experiments
1	**ASSIGNMENT ON INTRODUCTION TO ROBOT CONFIGURATION**
2	DEMONSTRATION OF ROBOT WITH 2 DOF, 3 DOF, 4 DOF etc.
3	TWO ASSIGNMENTS ON PROGRAMMING THE ROBOT FOR APPLICATIONS
4	TWO ASSIGNMENTS ON PROGRAMMING THE ROBOT FOR APPLICATIONS IN VAL II
5	TWO PROGRAMMING EXERCISES FOR ROBOTS
6	TWO CASE STUDIES OF APPLICATIONS IN INDUSTRY
7	EXERCISE ON ROBOTIC SIMULATION SOFTWARE

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

1. Two Tests each of **20 Marks**
2. Two assignments each of **10 Marks/One Skill Development Activity of 20 marks**
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

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SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2. The question paper will have ten questions. Each question is set for 20 marks.
3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
4. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course (CIE + SEE)

Suggested Learning Resources:

Books

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	To understand the basic components of robots.	5
CO2	Differentiate types of robots and robot grippers.	5
CO3	Model forward and inverse kinematics of robot manipulators.	4
CO4	Analyze forces in links and joints of a robot.	5
CO5	Programme a robot to perform tasks in industrial applications.	5

Program Outcome of this course

Sl. No.	Description	Pos
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	3	3	3	2	2
CO2	2	2	3	3	3	3	3
CO3	3	2	3	3	3	2	3
CO4	3	3	2	2	2	2	2
CO5	2	2	2	3	3	3	3

COMPUTER INTEGRATED MANUFACTURING SYSTEM			
Course Code	22MCM13	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 hour + 10-12 Activities	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives:

1. To train students with good scientific and engineering knowledge so as to comprehend, analyze, design, and create novel products and solutions for the real life problems.
2. To Impart knowledge to students in recent advances in the Computer Integrated Manufacturing Engineering to educate them to prosper in Manufacturing engineering and research related professions.

Module-1

Introduction to Computer integrated Manufacturing Systems: Manufacturing Systems, Types of Manufacturing Systems, Machine Tools and related equipment's, Material Handling Systems, Computer monitoring and control, Manufacturing support systems, The Product Cycle and CAD/CAM, Functions of computers in CIMS: CIMS Data Files, System Reports, Benefits of Computer integrated Manufacturing Systems.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

NC/CNC Machine Tools : General architecture of CNC Machine, Components of the CNC Systems: Machine Control Unit, CNC Driving system components: Hydraulic, Servo Motors, Stepper Motors, FeedbackDevices : Encoder, Resolver, Inducto syn, Tachometers, Counting devices.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Constructional Features of CNC Machines : Design considerations of CNC machines for improving machining accuracy, Structural Members, Slide ways, bearings, Re-circulating ball Screws, Spindle drives, Work holding devices and tool holding devices , Automatic tool changers.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

N.C Part Programming: Introduction, NC/ CNC programming methods: Manual part programming for turning and milling centers, G codes, M codes, canned cycles, Programming with CAD/CAM integration, CAM packages for CNC part program generation, Practical Exercises on CNC part programming.

Computer Controls in NC: CNC Technology: Functions of CNC Control in Machine Tools, Advantages of CNC, Direct Numerical Control (DNC Systems): Configuration of DNC system, Functions of DNC, Communication between DNC computer & MCU, Advantages of DNC.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Computerized Manufacturing Planning and Control Systems:

Computeraidedprocessplanning,VariantandGenerativeapproaches, Computer integrated production planning and control systems,

Typical production planning and control system, Material planning systems, Capacity planning, Shop Floor Control, Automatic identification, Automated data collection systems.

05Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **oneSkill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

.

Suggested Learning Resources:

Books

1. Groover, M.P.and Zimmers, E.W.,CAD/CAM: Computer Aided Design &Manufacturing,2006,Pearson Education India.
2. Mike llP. Groover and Emory W. Zimmer, Jr., CAD/CAM Computer Aided Design and Manufacturing, Prentice Hall India (P) Ltd,1992.
3. M.Koren—ComputerControlsofManufacturingSystems,McGrawHill,1983.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars
- Industrial Visit
- Case study relevant to present scenario

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Apply the concepts of machining for the purpose of selection of appropriate machining centers, machining parameters,	5
CO2	Create and demonstrate the technical documentation for design/ selection of suitable drive technologies, precision components and an overall CNC machine tool system for automation of machining operations.	5
CO3	Create and validate NC part program data using manual data input (MDI)	5
Co4	Design automated material handling and storage systems for a typical production system and control the process.	4
C05	Part model / part drawings using Computer Aided Manufacturing technology through programming, setup, and ensuring safe operation of Computer Numerical Control (CNC) machine tools.	5

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	3	3	2	2	2
CO2	3	3	3	2	2	2	1
CO3	2	2	2	3	3	3	1
CO4	3	3	3	2	2	1	1
CO5	2	2	3	3	3	2	2

CONTROL SYSTEM ENGINEERING			
Course Code	22MCM14	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs + 10-12 Activity Sessions	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

1. To provide the fundamental knowledge of control system engineering and the concept of mathematical modelling of the physical system.
2. The subject gives various classical analysis tools for design and stability of system in time and frequency domain.

Module-1

Motivation for control : Review of differential equations, impulse response and Laplace transformations, Introduction to state equations and transfer functions.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Interpretation of poles and zeros of transfer functions : Time domain response of second order system. Command tracking and system type. Rough/Hurwitz test.

05Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Frequency response and frequency domain methods: Nyquist stability test, Bodeplots. Phase and gain margins. Bode phase formula.
Robustness, Uncertainty and performance weights, Robust stability test, Robust performance test, Loop shaping necessary and sufficient conditions. Bode integral formula.

05Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Applications of Root locus, Sensitivity of roots of characteristics equation, Tool for design and analysis of control systems, Case studies using matlab on Bode, Nyquist and Root locus.

05Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

State variable analysis and design, Introduction, Concepts of state variables for linear discrete time systems, Diagonalization solutions of state equations, Concepts of controllability and observability, Pole placement by state feedback, Observer systems, problems.

05Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

Feedback Control of Dynamical Systems, 5thEdition, Franklin, Powell, and Enami-Naeini,Addison-Wesley,2006
Control Systems Engineering–I.J.Nagrath, M.Gopal, 5th Edition; New Age International (P) Ltd, Publishers.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars
- Industrial Visit

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Categorize different types of system and identify asset of algebraic equations to represent and model a complicated system into a more simplified form	4
CO2	Employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions and determine the (absolute) stability of a closed-loop control system.	5
CO3	Formulate different types of analysis in frequency domain to explain the nature of stability of the system.	5
C04	Apply root Locus technique to analyse and design control systems.	5
C05	Solve system equations in state-variable form (state variable models)	5

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	2	2	2
CO2	3	3	3	3	2	2	1
CO3	2	2	3	3	2	2	2
CO4	3	3	3	3	2	2	3
CO5	2	2	2	3	3	3	3

CNC Machines			
Course Code	22MCM15	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs + 10-12 Activity Sessions	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
The students are expected to be knowledgeable in Engineering product specification, CAD/CAM integration, CNC machine tool building, CNC programming using manual method, generation of CNC codes using CAM software, Tooling and work holding devices.

Module-1

INTRODUCTION TO CAM: The evolution of product realization, CAM and its historical development, Engineering product specification– Engineering design, design drafting, tolerance graph analysis, relationship between product and process tolerance, statistical quality control, manufacturing reliability. Geometric tolerancing- ASME standard, interpreting geometric specifications, multiple part features and datum.

05Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

CAD/CAM INTEGRATION: Networking- networking techniques, LAN, components, wiring methods, network interface cards, network standards, Graphics standards – Data exchange format, evolution- features of various interfaces GKS, IGES, DXF, PDES, STEP etc., Process planning, Computer Aided Process Planning(CAPP) - variant, generative approaches.

05Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

CONSTRUCTIONAL FEATURES OF CNC MACHINES: CNC Machine building, structural details, guide ways – Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion – Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, spindle assembly

05Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

PART PROGRAMMING FOR CNC MACHINES: Structure of CNC program, Coordinate system, G & M codes, cutter radius compensation, tool nose radius compensation, tool wear compensation, canned cycles, sub routines, do loop, mirroring features, Manual part programming for CNC turning and machining centre for popular controllers like Fanuc, Siemens, Generation of CNC program using CAM software.

05Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

TOOLING AND WORK HOLDING DEVICES: Introduction to cutting tool materials – HSS, Carbides, Ceramics, CBN, PCD, classification of inserts, PMK, NSH, qualified, semi qualified and preset tooling, tooling system for CNC Machining centre and Turning centre, Automatic Tool changers, work holding devices for rotating and fixed work parts, Automatic Pallet changer, economics of CNC, maintenance of CNC machines.

05Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

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Suggested Learning Resources:

Books

1. Chang,T.C., Wysk, R.A. and Wang,H.P., "Computer Aided Manufacturing", Pearson Prentice Hall, 2009.
2. Jones, B.L., "Introduction to Computer Numerical Control", Pitman, London, 1987.
3. "Mechatronics", HMT, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
4. Radhakrishnan, P., "Computer Numerical Control ", New Central Book Agency, 1992.
5. Rao, P.N., "CAD/CAM", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2010.
6. Seamers, W.S., "Computer Numeric Control", Fourth Edition – Thomson Delmar, 2002.
7. Singh, N., "Systems Approach to Computer-Integrated Design and Manufacturing", Wiley India Pvt. Ltd., 2011.
8. Zeid,I., "CAD - CAM Theory and Practice ", Tata McGraw-Hill Publishing Co. Ltd., 2007.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars
- Industrial Visit

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand the basic procedures and concepts of programming, set up and operation of a CNC Machining Center.	5
CO2	Identify and understand the basic programming codes	4
CO3	Create geometry and toolpaths from the specifications on a blueprint for simple parts using Mastercam programming software.	5
C04	Identify and define the functions of the CNC machine control.	5
Co5	Set up the CNC machining center for manufacturing simple parts	4

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	2	3	3
CO2	3	3	3	2	2	2	2
CO3	3	3	3	3	1	2	1
CO4	3	3	3	3	1	2	2
CO5	2	2	3	2	2	1	2

RESEARCH METHODOLOGY AND IPR			
Course Code	22RMI16	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

1. To give an overview of the research methodology and explain the technique of defining a research problem
2. To explain the functions of the literature review in research.
3. To explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
4. To explain various research designs and their characteristics.
5. To explain the details of sampling designs, and also different methods of data collections.
6. To explain the art of interpretation and the art of writing research reports.
7. To explain various forms of the intellectual property, its relevance and business impact in the changing global business environment.
8. To discuss leading International Instruments concerning Intellectual Property Rights

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India. Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration. 10Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area,Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed. Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs. 10Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Techniques, Multidimensional Scaling, Deciding the Scale.

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method. 10Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests ofHypothesis. Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using ChiSquareTests. 10Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5
Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers‟ Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation(WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules,Patents,Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO. 10Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

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1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

- Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg,New Age International,4th Edition, 2018.
- Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2), RanjitKumar,SAGE Publications,3rd Edition, 2011.
- Study Material (For the topic Intellectual Property under module 5), Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September2013.
- Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.
- Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.

Web links and Video Lectures (e-Resources):

- .VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Discuss research methodology and the technique of defining a research problem	5
CO2	Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review	4
CO3	Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.	4
CO4	Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports	4
CO5	Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leadingInternational Instruments concerning IPR	5

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	2	1	3
CO2	2	2	3	2	3	1	1
CO3	3	3	3	3	2	2	2
CO4	3	3	3	2	2	2	1
CO5	3	3	2	1	1	1	2

COMPUTER INTEGRATED MANUFACTURING LABORATORY -I			
Course Code	22MCML17	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:2:0	SEE Marks	50
Credits	02	Exam Hours	03

Course objectives:

1. To learn basic principles of Computer Integrated manufacturing procedure.
2. To learn the theory and concept that represent engineering applications
3. To apply skill base proficiency in CNC programming.

Sl.NO	Experiments
	PART A (Any SIX)*
1	Modeling and Simulation of Computer Integrated Manufacturing System
2	Modeling, Offline Manual Part Programming andSimulationoftheoperationofa3-axisCNCMillingMachine
3	Programming and operation of a 3-axis CNC Milling Machine
4	CAD/CAM based Part Programming and operation of a 3 axis CNC Milling Machine
5	Modeling, offline programming and simulation of a 5-Axis Robot manipulator
6	Programming and operation of a 5-Axis Robot manipulator
7	Machine vision based quality control
8	Remote Monitoring and Operation of a Computer Integrated Manufacturing System
	PART B (Any FOUR)
1	Generation of CNC program by optimizing tool path movement using CAM software for lathe and mill.
2	Exercises in tool pre-setting and work piece referencing on CNC machine tools, manual part programming For CNC turning and milling centres,
3	Use of software for simulation of turned and milled parts and simple surfaces, Automatic Cutter location Data generation from CAD Model sin APT format and post processing for machining on CNC machines using standard CAD/CAM software.
4	Simulation in section planning for automated inspection for an automotive component
5	Simulation of Product layout using plant simulation software
6	Factory floor simulation using suitable simulation software
7	Each student will submit a research assignment in terms of a short report and a small presentation on topic related to either design/selection criteria for critical CNC machine elements, CNC interpolation algorithms, need and designofspecialcontrolfeaturesinCNCcontroller,ordesignofCNCtoolpathalgorithms

Course outcomes:

At the end of the course the student will be able to:

- Write part programs for NC machining
- Simulate manufacturing processes before being put to actual machining
- Apply/ develop solutions or to do research in the areas of Design and simulation in Mechanical Engineering.
- Developing and applying computer software and hardware to mechanical design and manufacturing fields.
- Formulate relevant research problems ; conduct experimental and/ or analytical study and analyzing results with modern mathematical/scientific methods and use of software tools.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40%of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Suggested Learning Resources:

1) Remote(virtual) Experiments„ Computer Integrated Manufacturing (CIM)" from IIT Kharagpur (http://vlabs.iitkgp.ac.in/cim/#).
2) M.P.Groover, Automation Production systems and Computer Integrated manufacturing, Pearson Education,2015.
3) XunXu, Integrating advanced Computer Aided Design, Manufacturing and Numerical Control, IGI Global,2009
4) T.C.Chang,R.Wyskand H.P.Wang, Computer aided Manufacturing, Pearson Education,2009

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations and Syllabus
M.Tech., Computer Integrated Manufacturing (MCM)
(Effective from the Academic year 2022-23)

Registrar,
Visvesvaraya Technological University
Jnana Sangam, Machhe, Belagavi-590018
eMail: registrar@vtu.ac.in
contact: 0831-2498112

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2022
M.Tech.,**Computer Integrated Manufacturing (MCM)**
Choice Based Credit System (CBCS) and Outcome-Based Education (OBE)

II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Seminar	Tutorial/ Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1	PCC	22MCM21	Competitive Manufacturing Systems	02	00	02	03	50	50	100	3
2	IPCC	22MCM22	Pneumatic And Hydraulic Control	03	02	00	03	50	50	100	4
3	PEC	22MCM23x	Professional Elective -1	02	00	02	03	50	50	100	3
4	PEC	22MCM24x	Professional Elective- 2	02	00	02	03	50	50	100	3
5	MPS	22MCM25	Mini Project with Seminar	00	04	02	--	100	--	100	3
6	PCCL	22MCML26	Robotics and Automation Laboratory (Lab-II)	01	02	00	03	50	50	100	02
7	AUD/ AEC	22AUD27	Suggested ONLINE courses	Classes and evaluation procedures are as per the policy of the online course providers.							PP
TOTAL				**10**	**08**	**08**	**15**	**350**	**250**	**600**	**18**

Note: PCC: Professional core courses: Professional Elective Courses, IPCC-Integrated Professional Core Courses. MPS-Mini Project with Seminar; AUD/AEC; Audit Courses / Ability Enhancement Courses (Mandatory), PCCL-Professional Core Course lab,
L-Lecture, P-Practical, T/SDA-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

Professional Elective-1		**Professional Elective- 2**	
Course Code under 22MCM23X	**Course title**	**Course Code under 22MCM24X**	**Course title**
22MCM/CAE231	Additive Manufacturing	22MCM241	3D Printing and Rapid Manufacturing
22MCM/MTE/MPD 232	Value Engineering	22MCM242	Drives and Control Systems for Automation
22MCM233	Machine Learning	22MCM243	Virtual Reality & Augmented Reality
22MCM234	Metrology and Computer Aided Inspection	22MCM244	Work Systems Engineering
22MCM235	Advanced Computer concept for Automation	22MPD/MAU/MDE/ MEA/MMD/MTP/M PY/MIA/MAR/CAE/	Industry 4.O

Note:
1 Mini Project with Seminar: This may be hands-on practice**,** survey report, data collection and analysis, coding, mobile app development, field visit and report preparation, modelling of system, simulation, analysing and authenticating, case studies, etc.
CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Students can present the seminar based on the completed mini-project. Participation in the seminar by all postgraduate students of the program shall be mandatory.
The CIE marks awarded for Mini-Project work and Seminar, shall be based on the evaluation of Mini Project work and Report, Presentation skill and performance in Question-and-Answer session in the ratio 50:25:25. Mini-Project with Seminar shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the Mini Project and Seminar shall be declared as fail in that course and have to complete the same during the subsequent semester. There is no SEE for this course.
2. Internship: All the students shall have to undergo a mandatory internship of **06 weeks** during the vacation of II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted in the same semester. The internship shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in the internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

Semester- II

COMPETITIVE MANUFACTURING SYSTEMS			
Course Code	22MCM21	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs+ 10-12 Activity Sessions	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

To emphasize the knowledge on the quality improvement, automation, and advanced manufacturing techniques to create the highest-caliber products quickly, efficiently, inexpensively, and in synchronization with the marketing, sales, and customer service of the company

Module-1

MANUFACTURING IN A COMPETITIVE ENVIRONMENT: Automation of manufacturing process - Numerical control - Adaptive control - material handling and movement - Industrial robots - Sensor technology - flexible fixtures - Design for assembly, disassembly and service.

5Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

GROUP TECHNOLOGY & FLEXIBLE MANUFACTURING SYSTEMS Part families - classification and coding - Production flow analysis - Machine cell design - Benefits. Components of FMS - Application work stations - Computer control and functions - Planning, scheduling and control of FMS - Scheduling - Knowledge based scheduling - Hierarchy of computer control - Supervisory computer.

5Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

COMPUTER SOFTWARE, SIMULATION AND DATABASE OF FMS System issues - Types of software - specification and selection - Trends - Application of simulation - software - Manufacturing data systems - data flow - CAD/CAM considerations - Planning FMS database.

5Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

LEAN MANUFACTURING Origin of lean production system – Customer focus – Muda (waste) – Standards – 5S system – Total Productive Maintenance – standardized work –Man power reduction – Overall efficiency - Kaizen – Common layouts - Principles of JIT - Jidoka concept – Poka-Yoke (mistake proofing) - Worker Involvement– Quality circle activity – Kaizen training - Suggestion Programmes – Hoshin Planning System (systematic planning methodology) – Lean culture.

5Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

JUST IN TIME Characteristics of JIT - Pull method - quality -small lot sizes - work station loads - close supplier ties – flexible work force - line flow strategy - preventive maintenance - Kanban system – strategic implications - implementation issues - Lean manufacture.

5Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing ", Third Edition, Prentice-Hall, 2007.
2. Jha, N.K. "Handbook of Flexible Manufacturing Systems ", Academic Press Inc., 1991.
3. Kalpkjian, "Manufacturing Engineering and Technology ", Addison-Wesley Publishing Co., 1995.
4. Pascal Dennis, "Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System", (Second edition), Productivity Press, New York, 2007.
5. Taiichi Ohno, Toyota Production System Beyond Large-Scale Production, Productivity Press, 1988.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Learn manufacturing in a competitive environment	3
CO2	Learn group technology & flexible manufacturing systems	3
CO3	Learn computer software, simulation and database of FMS.	4
CO4	Learn on lean manufacturing	5
CO5	Learn about just in time	4

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	2	3	2	2	1
CO2	3	3	3	2	1	2	1
CO3	3	3	3	3	3	2	2
CO4	3	3	2	2	2	2	1
CO5	3	3	2	2	2	2	2

PNEUMATIC AND HYDRAULIC CONTROL			
Course Code	**22MCM22**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

1. Understanding the basic design rules for Pneumatics and hydraulics.
2. Applying the process for ease flow control.
3. Analyze factors for flow control.
4. Apply the concepts of hydraulics for computer integrated manufacturing.
5. To understand Manufacturing processes and assembly techniques required for hydraulic systems.

MODULE-1	
Introduction to pneumatics, types and classification of pneumatics, Introduction to control system, Types of control system and their utility. 08Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE-2	
Hydraulic power generation and transmission, valve control pressure flow relationship for hydraulic valves, valve configurations and constructions, steady state operating forces, transient forces and valve instability. Circuit design. 08Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE-3	
Introduction to pneumatic control, choice of working media, characteristics of compressed air, structure of pneumatic control systems. Pneumatic valves, Hydraulic and pneumatic drives and their applications 08Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE-4	
Fluidics: Introduction to fluidic devices and sensors lumped and distributed parameter fluid systems. Fluid mechanics of jets, wall attachment and vortex devices. Pure fluidic analog amplifiers. Analog signal control techniques. Design of pure fluid digital elements 08Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE 5	
Electro-hydraulic and Electro-pneumatic Systems: Physical concepts of pneumatics and electrical. Electro-pneumatic components operation and application interpretation of electric ladder diagram. P.PI& PID– controllers & applications. 08Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Study of Speed Control Circuit on Hydraulic Trainer
2	Study of Sequencing Circuit on Hydraulic Trainer
3	Study of Synchronizing Circuit on Hydraulic Trainer

4	Study of Regenerative Circuit on Hydraulic Trainer
5	Study of Counterbalancing Circuit on Hydraulic Trainer
6	Design and assembly of hydraulic / pneumatic circuit

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

1. Two Tests each of **20 Marks**
2. Two assignments each of **10 Marks/One Skill Development Activity of 20 marks**
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test at the end /after completion of all the experimentsshall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2. The question paper will have ten questions. Each question is set for 20 marks.
3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
4. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course (CIE + SEE)

Suggested Learning Resources:

Books

- K.Foster,G.P.Parker,FluidicComponentsand Circuits,Wiley,1970.
- A.B.Goodwin, FluidPowerSystems,Macmillan,1976.
- OilHydraulicSystemsbyS.R.Majumdar,TataMegrawHillPub.Co.Ltd.2001
- PneumaticSystemsbyS.R.Majumdar,TataMegrawHillPub.Co.Ltd.1995
- HydraulicandPneumaticControlbySrinivasan,VijayNikole,ImprintsPvt.Ltd.2004
- HydraulicControlofMachineToolsbyKhaimovich,PergamonPressLtd.196
- JohnPippenger,TylerHicks,IndustrialHydraulics,McGrawHillInternationalEdition,1980.
- MajumdarS.R.,"OilHydraulics",TataMcGraw-Hill,2000.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Correlate the basics of hydraulics to the performance of fluid power systems.	5
CO2	Describe the working principle of hydraulic systems including pumps and controllers.	4
CO3	Correlate the basics of pneumatics to the performance of pneumatic systems.	5
CO4	Design and analyse problems relating to Pneumatic and Hydraulic control systems and components.	4
CO5	Design hydraulic and pneumatic power circuits.	5

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COs and Pos (Indicative Only)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	2	2	1
CO2	3	3	3	2	2	2	3
CO3	3	3	2	2	1	1	2
CO4	3	3	3	2	2	3	2
CO5	3	3	3	2	2	2	1

Professional Elective-I

ADDITIVE MANUFACTURING

Course Code	22MCM/CAE231	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs+10-12 Activity Sessions	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

1. To educate students with fundamental and advanced knowledge in the field of Additive manufacturing technology
2. Gain insights on the need, advantages and limitations of Additive Manufacturing (AM) versus traditional manufacturing
3. Find out the various applications of AM, Deployment levels, Innovative and optimized product design
4. To explore the potential of additive manufacturing in different industrial sectors.
5. To apply 3D printing technology for additive manufacturing.

Module-1

Introduction: Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes- Benefits- Applications.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

REVERSE ENGINEERING AND CAD MODELLING : Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modelling techniques: Wire frame, surface and solid modelling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS : Stereo lithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modelling (FDM): Principle, details of processes, process variables, types, products, materials and applications.

05 Hrs

	Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
	Module-4	
	POWDER BASED ADDITIVE MANUFACTURING SYSTEMS: Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies. 05 Hrs	
	Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
	Module-5	
	OTHER ADDITIVE MANUFACTURING SYSTEMS: Three-dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. 05 Hrs	
	Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**
CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

.

Suggested Learning Resources:

Books

1. Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", second edition, World Scientific Publishers, 2010.
2. Gebhardt, A., "Rapid prototyping", Hanser Gardener Publications, 2003.
3. Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
4. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.
6. Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
7. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2011.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Bloom
CO1	The students are expected to learn about a variety of Additive Manufacturing (AM) technologies.	5
CO2	Describe additive manufacturing and explain its advantages and disadvantages	5
CO3	Explain the processes used in additive manufacturing for a range of materials and applications	5
CO4	understand the role of additive manufacturing in the design process and their potential to support Design and manufacturing,	5
CO5	Case studies relevant to mass customized manufacturing, and some of the important research challenges associated with AM and its data processing tools	5

Program Outcome of this course

Sl. No.	Description	P
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	32	2	2	3
CO2	3	3	3	3	2	2	1
CO3	3	2	1	2	3	3	3
CO4	3	3	3	2	2	3	3
CO5	3	3	2	1	3	3	3

VALUE ENGINEERING			
Course Code	22MCM/MTE/MPD232	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To inculcate specialized knowledge and skill in advanced manufacturing processes using the principles and methods of engineering analysis and design.

Module-1

INTRODUCTION TO VALUE ANALYSIS: Definition of Value, Value Analysis, Value Engineering, Value management, Value Analysis versus Value Engineering, Value Analysis versus Traditional cost reduction techniques, Symptoms to apply value analysis, Coaching of Champion concept. TYPE OF VALUES: Reasons for unnecessary cost of product, Peeling cost Onion concept, unsuspected areas responsible for higher cost, Value Analysis Zone, attractive features of value analysis. Meaning of Value, types of value & their effect in cost reduction. 10 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

FUNCTIONAL COST AND ITS EVALUATION: Meaning of Function and Functional cost, Rules for functional definition, Types of functions, primary and secondary functions using verb and Noun, Function evaluation process, Methods of function evaluation. Evaluation of function by comparison, Evaluation of Interacting functions, Evaluation of function from available data, matrix technique, MISS technique, Numerical evaluation of functional relationships and case studies. PROBLEM SETTING & SOLVING SYSTEM: A problem solvable stated is half solved, Steps in problem setting system, Identification, Separation and Grouping of functions. Case studies. 10Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

VALUE ENGINEERING JOB PLAN: Meaning and Importance of Value Engineering Job plan. Phases of job plan proposed by different value engineering experts, Information phase, Analysis phase, Creative phase, Judgement phase, Development planning phase, and case studies. Cost reduction programs, criteria for cost reduction program, Value analysis change proposal.

10Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

VALUE ENGINEERING TECHNIQUES: Result Accelerators or New Value Engineering Techniques, Listing, Role of techniques in Value Engineering, Details with Case examples for each of the Techniques. ADVANCED VALUE ANALYSIS TECHNIQUES: Functional analysis system technique and case studies, Value analysis of Management practice (VAMP), steps involved in VAMP, application of VAMP to Government, University, College, Hospitals, School Problems etc., (service type problems). 10 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

APPLICATION OF VALUE ANALYSIS: Application of Value analysis in the field of Accounting, Appearance Design, Cost reduction, Engineering, manufacturing, Management, Purchasing, Quality Control, Sales, marketing, Material Management Etc., Comparison of approach of Value analysis & other management techniques.

10Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks**to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

- Techniquesof Value Analysis and Engineering– Lawrence D. Miles, McGraw – Hill Book Company,2ndEdn.
- Value engineering for Cost Reduction and Product Improvement – M.S. Vittal, Systems Consultancy Services Edn 1993
- Value Management, Value Engineering and Cost Reduction – Edward D Heller Addison Wesley Publishing Company 1971
- Value Analysis for Better Management – Warren J Ridge American Management Association Edn 1969
- Getting More at Less Cost (The Value Engineering Way) – G.Jagannathan Tata Mcgraw Hill Pub. Comp. Edn 1995
- Value Engineering – Arther E Mudge McGraw Hill Book Comp. Edn 1981

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Activities

- Mini project on live working model/ Problems.
- Seminar
- Assignment

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	To understand the concepts of value engineering, identify the advantages, applications.	
CO2	To understand various phases of value engineering. Analyze the function, its approach and evaluation.	
CO3	To learn queuing theory	
CO4	To evaluate the value engineering operation in maintenance and repair activities. Learning	
CO5	To create the value engineering team and discuss the value engineering case studies.	

Sl. No.	Description	POs
PO1	An ability to independently carry out research /investigation and development work to solve practical problems.	
PO2	An ability to write and present a substantial technical report/document.	
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	
PO4	Understand contemporary issues in manufacturing engineering and develop relationship between product design and manufacturability to create safe, reliable, and cost-effective products.	
PO5	Understand the process of converting customer needs into engineering specifications to create product designs that are sensitive to user needs and robust against unanticipated uses and misuse	
PO6	Employ advanced prototyping methods to shorten design cycles and narrow alternatives without restricting innovation.	
PO7	Understand and debate the roles and responsibilities of a product designer/manufacturer on society.	

Mapping of COS and Pos (indicative only)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**2**	**2**	**3**	**3**	**3**
CO2	**3**	**2**	**2**	**2**	**3**	**2**	**3**
CO3	**2**	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**2**	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**2**	**2**	**2**	**2**

Note : High - 1, Medium – 2, and Low – 3

Professional Elective-I			
MACHINE LEARNING			
Course Code	22MCM233	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs+10-12 Activity Sessions	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
To discover patterns in the user data and then make predictions based on these and intricate patterns for answering business questions and solving business problems.

Module-1

Introduction, Concept Learning and Decision Trees Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Version Spaces and Candidate Elimination Algorithm – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Neural Networks and Genetic Algorithms: Neural Network Representation – Problems – Perceptron‟s – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evolution and Learning.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Bayesian and Computational Learning Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier– Bayesian Belief Network – EM Algorithm – Probably Learning – Sample Complexity for Finite and Infinite Hypothesis Spaces – Mistake Bound Model

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Instant Based Learning and Learning Set of Rules: K- Nearest Neighbor Learning – Locally Weighted Regression – Radial Basis Functions – Case-Based Reasoning – Sequential Covering Algorithms – Learning Rule Sets – Learning First Order Rules – Learning Sets of First Order Rules – Induction.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Analytical Learning and Reinforced Learning: Perfect Domain Theories – Explanation Based Learning – InductiveAnalytical Approaches - FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

.

Suggested Learning Resources:

Books

(1) Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013.

(2)EthemAlpaydin, "Introduction to Machine Learning", 2nd Ed., PHI Learning Pvt. Ltd., 2013.

Reference Books

(1) Stephen Marsland, Machine Learning: An Algorithmic Perspective

(2) T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer; 1st Edition, 2001

(3) Tom Mitchell, Machine Learning,

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Design the learning system for learning problem with this basic knowledge	5
CO2	Apply effectively neural networks and genetic algorithms for appropriate applications.	5
CO3	Apply bayesian techniques for classification problems	5
CO4	Derive effectively learning rules for appropriate learning systems.	5
CO5	Choose and differentiate reinforcement and analytical learning techniques	5

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**2**	**3**	**3**	**3**	**2**	**2**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**2**	**2**	**1**	**1**
CO4	**3**	**3**	**3**	**2**	**2**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**	**2**

Professional Elective-I			
METROLOGY AND COMPUTER AIDED INSPECTION			
Course Code	22MCM234	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs+10-12 Activity Sessions	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

1. To learn various concepts of instrumentation, metrology & computer assisted inspection.
2. To have practical view of various measuring, gauging instruments.

Module-1

Metrology and Techniques: Standards in metrology, definitions, Traceability, Characteristics Length & Angular measurements – Review of standard instruments, G D and tolerance procedure-Review of dimension & form tolerance and methods of measurement, Tolerance analysis, Surface metrology Instruments, Methods and new approaches.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Laser Applications in Metrology: LASER light source, LASER interferometer, LASER alignment telescope, LASER micrometer,On-line and in-process measurements of diameter, Roundness and surface roughness using LASER, Micro Holes and topography measurements.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Special Measuring Instruments and Techniques: Opto electronic devices, contact and non-contact types, Applications in on-line and in-process monitoring systems, Tool wear measurement, Surface measurement, Machine vision, shape identification, Edge detection techniques, Normalisation, gray scale correlation, Template Techniques, Surface roughness using vision system, Interfacing robot and image processing system.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Co-ordinate Measuring Machine: Types of CMM, Probes used, Applications, Non-contact CMM using electro optical sensors for dimensional metrology, Non-contact sensors for surface finish measurements, statistical evaluation of data using computer, Data integration of CMM and data logging in computers.

04 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Sensors in Inspection: Manufacturing applications of photo detectors, deflection methods-beam detection, Reflex detection, & Proximity detection, Applications of Inductive and Capacitive proximity sensors, Understanding microwave sensing applications laser sensors and limit switches. Advanced sensor technology - Bar code systems, Principles and applications of Colour sensors, electro-magnetic identifier, Tactile sensors,Ultrasonic sensors,Odour Sensors.

06 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

.

Suggested Learning Resources:

Books

- Fundamentals of dimensional Metrology T.Buschand R.Harlow Delmar,3e
- Engineering Metrology G.Thomasand G.Butter Worth PUB
- Sensors and Control systems in Manufacturing Sabne Soloman McGrawHillBook
- Measurement systems: Applications & Design Doebelin International Student Edition

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Acquire the basic knowledge and practice regarding Quality Assurance through different Computer Aided Inspection and Newest Metrology Precision Instruments.	5
CO2	Basic information and real time applications of LASER technology in the field.	4
CO3	Get knowledge f modern measuring techniques their application for Digitizing the Production Time.	3
CO4	Get knowledge applications and principal of CMM mechanics	5
CO5	Apply various sensors for process control and product quality monitoring.	5

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**2**	**3**	**2**	**2**
CO2	**3**	**3**	**3**	**3**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO5	**2**	**2**	**3**	**3**	**3**	**3**	**2**

Professional Elective-I			
ADVANCED COMPUTER CONCEPT FOR AUTOMATION			
Course Code	22MCM235	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs+10-12 Activity Sessions	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
To Understand the concept in advanced in computer automation and solving business problems.

Module-1

Introduction: Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes-Benefits- Applications.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

REVERSE ENGINEERING AND CAD MODELLING : Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modelling techniques: Wire frame, surface and solid modelling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS : Stereolithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modelling (FDM): Principle, details of processes, process variables, types, products, materials and applications.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

POWDER BASED ADDITIVE MANUFACTURING SYSTEMS : Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

OTHER ADDITIVE MANUFACTURING SYSTEMS : Three-dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballastic Particle Manufacturing (BPM), Selective Laser Melting, Electron Beam Melting.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

3. Three Unit Tests each of **20 Marks**
4. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

6. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
7. The question paper will have ten full questions carrying equal marks.
8. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
9. Each full question will have a sub-question covering all the topics under a module.
10. The students will have to answer five full questions, selecting one full question from each module

.

Suggested Learning Resources:

Books

(1) Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013.

(2)EthemAlpaydin, "Introduction to Machine Learning", 2nd Ed., PHI Learning Pvt. Ltd., 2013.

Reference Books

(1) Stephen Marsland, Machine Learning: An Algorithmic Perspective

(2) T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer; 1st Edition, 2001

(3) Tom Mitchell, Machine Learning,

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Design the learning system for learning problem with this basic knowledge	5
CO2	Apply effectively neural networks and genetic algorithms for appropriate applications.	5
CO3	Apply bayesian techniques for classification problems	5
CO4	Derive effectively learning rules for appropriate learning systems.	5
CO5	Choose and differentiate reinforcement and analytical learning techniques	5

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**2**	**3**	**3**	**3**	**2**	**2**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**2**	**2**	**1**	**1**
CO4	**3**	**3**	**3**	**2**	**2**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**	**2**

Professional Elective-2			
3D PRINTING AND RAPIDMANUFACTURING			
Course Code	22MCM241	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
The objective of this course is to impart students to the fundamentals of various 3D Printing Techniques for application to various industrial needs.

Module-1

Introduction: Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems Stereo Lithography Systems: Principle, Process parameter, Process details, Data preparation, data files and machine details,

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Selective Laser Sintering and Fusion Deposition Modeling: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications, Principle of Fusion deposition modeling, Process parameter.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Solid Ground Curing: Principle of operation, Machine details, Applications. Laminated Object Manufacturing: Principle of operation. Process details, application.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Concepts Modelers: Principle, Thermal jet printer, Sander's model market. GenisysXs printer HP system 5, object Quadra systems.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Rapid Tooling:. Indirect Rapid tooling -Silicone rubber tooling –Aluminum filled epoxy tooling Spray metal tooling, Cast kirksite, 3Q keltool, etc Direct Rapid Tooling., AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling. RP Process Optimization: Factors influencing accuracy. Data preparation errors, Partbuilding errors, Error in finishing.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

.

Suggested Learning Resources:

Books

(1) Stereo lithography and other RP & M Technologies- Paul F. Jacobs, SME, NY 1996.
(2) Rapid Manufacturing- Flham D.T &DinjoyS. S, Verlog London 2001.
(3) Rapid automated- Lament wood, Indus press New York, 1st edition, 1993

Reference Books

(1) D.T. Pham and S.S. Dimov, "Rapid Manufacturing", Springer, 2001
(2) Chua C.K., Leong K.F. and LIM C.S Rapid prototyping: Principles an Applications, World Scientific publications, 3rdEd., 2010
(3) Ian Gibson, Davin Rosen, Brent Stucker "Additive Manufacturing Technologies, Springer, 2nd Ed, 2014

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Analyse, design and evaluate engineering products using the knowledge of mathematics, science, engineering and IT tools.	
CO2	Solve complex manufacturing problems for significant technological and societal development	
CO3	Apply additive manufacturing concepts to all possible fields of human life.	
CO4	Engage in lifelong learning to adapt to changing needs for professional advancement.	

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	2	3	2
CO2	3	3	2	1	2	3	2
CO3	3	3	3	3	2	1	2
CO4	3	3	3	3	3	2	1

Professional Elective-2			
DRIVES AND CONTROL SYSTEMS FORAUTOMATION			
Course Code	22MCM242	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs+10-12 Activity Sessions	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

To prepare the students for acquiring the knowledge and applications of different types of Industrial drives including special electric drives controlled with various power electronic converters.

Module-1

Introduction: Working principle of synchronous, Asynchronous & stepper motors, Difference between Induction andservomotors,Torquev/sspeedcharacteristics,Powerv/s.Speedcharacteristics,Vectordutyinductionmotors,Conceptsoflinearandframeless motors, Selectionof feedbacksystem,Dutycycle.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Industrials Drives: DC and AC motors operation and selection, method of control and application of brushless DC motor, PMSM, stepper motor, A.C servomotor, selection criteria for servo motor and servo amplifier, universal motor, electric drive, types of industrial drives, the characteristics of drive, advantages of drives over other prime movers, motor rating, heating effects 05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Motion Laws For Rotary And Linear Systems: converting rotary to linear system, concepts and principles of ballscrews, rack and pinion, belt and pulley, chain drives, gear drives, Selection of converting systems, Dynamic responsegearing,andcontrolapproachesofRobots,ControlloopsusingCurrentamplifier

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Introduction to Programmable Logic Controllers: Definitions of PLC, basic structure of PLC, working principles, data storage methods, inputs / outputs flag processing‟s, types of variables, definition of firmware, software. 05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Logic, Instructions & Application of PLC: What is logic, Conventional Ladder v/s PLC ladder, series and parallel function of OR, AND, NOT logic, Ex Or logic, Analysis of rung. Timer and Counter Instructions; on delay and Off delay and retentive timer instructions.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

.

Suggested Learning Resources:

Books

(1) Process Control Instrumentation Technology, Johnson Curties, Prentice hall of India, 8th edition Andrew Parr, Industrial drives, Butterworth – Heineamann
(2) Andrew Parr, Industrial drives, Butterworth – Heineamann
(3) G.K. Dubey. Fundamentals of electrical drives
(4) Programmable Logic Controllers by W.Bolton

Reference Books

(1) Introduction to Programmable Logic Controllers by Garry Dunning, 2nd edition, Thomson, ISBN:981-240-625-5
(2) Instrumentation Engineers Hand Book - Process Control, Bela G Liptak, Chilton book company, Pennsylvania
(3) A.E. Fitzerald , C. Kingsley and S.D Umans, Electric Machinery - McGraw Hill Int. Student edition
(4) S.K. Pillai. A First course on electric drives –Wiley Eastern 1990
(5) Programmable Logic Controllers by Hugh Jack.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand the basics of Electric drives	5
CO2	Explain industrial processes and selection of drives	5
CO3	Differentiate various control systems	5
CO4	Illustrate computer based industrial control	5
CO5	Describe Electric traction	4

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
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Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	3	2	2	2
CO2	3	3	3	3	2	2	1
CO3	2	2	1	2	3	1	2
CO4	3	3	3	2	2	1	2
CO5	2	2	1	2	3	3	3

Professional Elective-2

VIRTUAL REALITY & AUGMENTED REALITY

Course Code	22MCM243	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs+ 10-12 Activity Sessions	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

1. Provides the student with basic knowledge of the industrial automation systems design, installation, modification, maintenance, and repair.
2. To study about various sensors and its industrial applications.

Module-1

Introduction to Virtual Reality Fundamental Concept and Components of Virtual Reality, Primary Features and Present Development on Virtual Reality, Multiple Modals of Input and Output Interface in Virtual Reality, Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based 3D Menus & 3DScanner etc; Output -- Visual /Auditory / Haptic Devices.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Visual Computation in Virtual Reality (1) Fundamentals of Computer Graphics; Real time rendering technology; Principles of Stereoscopic Display; Software and Hardware Technology on Stereoscopic Display

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Environment Modeling in Virtual Reality Geometric Modeling; behaviour Simulation; Physically Based Simulation, Haptic & Force Interaction in Virtual Reality Concept of haptic interaction; Principles of touch feedback and force feedback; Typical structure and principles of touch/force feedback facilities in application

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Augmented Reality System Structure of Augmented Reality; Key Technology in AR; General solution for calculating geometric & illumination consistency in the augmented environment.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

VR Development Tools Frameworks of Software Development Tools in VR; Modeling Tools for VR; X3D Standard;Vega, MultiGen, Virtools.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.

The students will have to answer five full questions, selecting one full question from each module

.

Suggested Learning Resources:

Books

(1) Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.
(2) Edward Angel, "Interactive Computer Graphics: A Top-Down Approach Using OpenGL", Addison-Wesley
(3) 2009. Donald Hearn and Pauline Baker, "Computer Graphics C Version", Pearson Education, 2002.

Reference Book

(1) Sherman, William R. and Alan B. Craig. Understanding Virtual Reality – Interface, Application, and Design, Morgan Kaufmann, 2002.
(2) Fei GAO. Design and Development of Virtual Reality Application System, Tsinghua Press, March 2012.
(3) Guangran LIU. Virtual Reality Technology, Tsinghua Press, Jan. 2011.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Describe Virtual Reality concepts and its implication	5
CO2	Illustrate the Input-Output interactions in Virtual Reality	5
CO3	Interpret the need of Visual Computation and role of Computer Graphics in Virtual reality	5
CO4	Illustrate the role of modeling and simulation in Virtual Reality	4
CO5	Demonstrate the tools aiding Virtual Reality Frameworks	5

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	2	3	2	1	2
CO2	2	2	2	3	3	1	1
CO3	3	3	3	3	2	1	1
CO4	3	3	3	2	1	2	3
CO5	3	3	3	2	1	2	3

Professional Elective-2			
WORK SYSTEMS ENGINEERING			
Course Code	22MCM244	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs+ 10-12 Activity Sessions	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

1. Student obtains a foundational knowledge of systems engineering processes and practices.
2. Student uses the knowledge and information gained in the course to expand and improve the application of systems engineering in their field.

Module-1

Productivity and Work Study: Productivity concepts and definitions, productivity Vs standard of living, Techniques for productivity improvement, Measuring productivity of an enterprise, materials, land, building, machines and man power. Methods Study: Selection of job, record - examine - develop, movement of workers, materials, tools for recording the movement of workers.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Principles of Motion Economy: Classification of movements, two handed process charts, Micro motion study (therbligs), memo motion study, simo chart, chronocycle graph, recording techniques, define-install-maintain

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Work Measurement: Definition, basic procedure, techniques, work sampling, determination of sample size, conducting work sampling study, performance rating systems, various types of allowances.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Time Study: Equipment, forms, selecting the job and worker, basic steps, classification of elements, breaking the job into elements, determination of sample size. Techniques for Work Measurements: Stop watch time study, work sampling, PMTS, MTM, analytical estimation.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Influence of Working Conditions in Work Study: Layout and housekeeping, lighting, noise, vibration, ergonomics, fire prevention and protection, OSHA.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

- ILO, "Introduction to Work Study: Indian Adaptation", Oxford and IBH Publishing Company Private Limited,2008.
- Ralph M Barnes, "Motion and Time: Study Design and Measurement of Works", John Wiley & Sons Inc.,2002.
- Benjamin W Niebel, "Motion and Time Study - An Introduction to Methods, Time Study and Wage Payment",Richard Dirwin, Illinois, 1958.
- Barnes,Raeph.m., "MotionandTimeStudy –DesignandMeasurementofWork",John Wiley&sons,New York,1990
- Mc.Cormick,E.J.,"HumanFactorsinEngineeringandDesign",Mc.GrawHill.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Measure the work flow and use the tools and technics to improve the productivity	5
CO2	Carryout the micro motion study and optimize the movements.	5
CO3	Design the sample size to analyses the work study	5
CO4	Classified the various elements to time study	5
CO5	Design the pant to more ergonomic way by considering all specified industry norms	5

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	2	2	3	3	3
CO2	3	3	3	3	3	2	2
CO3	3	3	3	3	3	2	2
CO4	3	2	2	2	1	2	2
CO5	3	3	3	3	3	2	2

Professional Elective -4			
INDUSTRY 4.O			
Course Code	22MPD/MAU/MDE/MEA/MMD/MTP/MPY/MIA/MAR/CAE/MPE/MPM/MCM245	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 theory + 10-12 activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To impart basic idea in Industry 4.0.
- To provide students with good depth of knowledge of designing Industrial 4.0 Systems for various application
- Learn the concepts of Robotics and Augmented Reality

Module-1	
Introduction to Industry 4.0: Introduction, core idea of Industry 4.0,origin concept of industry 4.0,Industry 4.0 production system, current state of industry 4.0, Technologies, How is India preparing for Industry 4.0 05Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2	
A Conceptual Framework for Industry 4.0: Introduction, Main Concepts and Components of Industry 4.0, State of Art, Supportive Technologies, Proposed Framework for Industry 4.0. 05Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3	
Technology Roadmap for Industry 4.0 : Introduction, Proposed Framework for Technology Roadmap, Strategy Phase, Strategy Phase, New Product and Process Development Phase. 05Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4	
Advances in Robotics in the Era of Industry 4.0: Introduction, Recent Technological Components of Robots-Advanced Sensor Technologies, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber-Physical Robotics, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly. 05Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5	
Obstacles and Framework Conditions for Industry 4.0 : Lack of A Digital Strategy alongside Resource Scarcity, Lack of standards and poor data security, Financing conditions, availability of skilled workers, comprehensive broadband infra- structure, 05Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

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CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

- Alp Ustundag and Emre Cevikcan,"Industry 4.0: Managing the Digital Transformation".
- Bartodziej, Christoph Jan,"The Concept Industry 4.0".
- Klaus Schwab,"The Fourth Industrial Revolution".
- Christian Schröder ,"The Challenges of Industry 4.0 for Small and Medium-sized Enterprises".

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars
- Industrial Visit
- Case study

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Describe Industry 4.0 and scope for Indian Industry	
CO2	Demonstrate conceptual framework and road map of Industry 4.0	
CO3	Describe Robotic technology and Augmented reality for Industry 4.0	
CO4	Demonstrate obstacle and framework conditions for Industry 4.0	

Program Outcome of this course

Sl. No.	Description	POs
PO1	An ability to independently carry out research /investigation and development work to solve practical problems.	
PO2	An ability to write and present a substantial technical report/document.	
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	
PO4	Understand contemporary issues in manufacturing engineering and develop relationship between product design and manufacturability to create safe, reliable, and cost-effective products.	
PO5	Understand the process of converting customer needs into engineering specifications to create product designs that are sensitive to user needs and robust against unanticipated uses and misuse	
PO6	Employ advanced prototyping methods to shorten design cycles and narrow alternatives without restricting innovation.	
PO7	Understand and debate the roles and responsibilities of a product designer/manufacturer on society.	

Mapping of COS and Pos (indicative only)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	3	2	3	3
CO2	2	3	3	2	3	3	3
CO3	3	3	2	3	2	3	3
CO4	3	2	2	3	2	3	3

Note : High - 1, Medium – 2, and Low – 3

ROBOTICS AND AUTOMATION LABORATORY			
Course Code	20MCML26	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

Sl.NO	Experiments
	PART A (Minimum Five)
1	Experimental study on direct operation of Single acting and Double acting cylinder
2	Design a circuit for Speed Control of Double acting cylinder meter-in by employing 4/2 DC solenoid valve Design a circuit for Speed Control of Double acting cylinder meter-out by employing 4/3 DC solenoid valve
3	Design a circuit for Speed Control of hydraulic motor meter-in circuit by employing 4/2 DC valve Design a circuit for Speed Control of hydraulic motor meter-out circuit by employing 4/3 DC valve
4	Study of power steering apparatus
5	Study of Shock single acting and double acting and double acting shock absorber
6	Study of air suspension
	PART B (Minimum Five)
7	PLC programing on Automatic Bottle filling system
8	Application of PLC for Traffic Light Control
9	Develop the PLC Program to control level of water level controller
10	Develop the PLC Program to control batch process reactor

11	lift control system using PLC
12	Starting Three Phase induction Motors via Star-Delta Starter using PLC
13	Pressure Control Using PLC
14	Temperature Control Using PLC
	PART C (Optional)
15	Substation Automation with SCADA
16	Robotic Programming for various functions Fanuc/Simons controller

Course outcomes:

At the end of the course the student will be able to:

- Write part programs for NC machining
- Program and control robot path for industrial applications.
- Simulate manufacturing processes before being put to actual machining

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations and Syllabus
M.Tech., Computer Integrated Manufacturing (MCM)
(Effective from the Academic year 2022-23)

Registrar,
Visvesvaraya Technological University
Jnana Sangam, Machhe, Belagavi-590018
eMail: registrar@vtu.ac.in
contact: 0831-2498112

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2022
M.Tech.,**Computer Integrated Manufacturing (MCM)**
Choice Based Credit System (CBCS) and Outcome-Based Education (OBE)

III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Mini–Project/ Internship	Tutorial/ Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1	PCC	22MCM31	Artificial Intelligence and Expert System in Automation	03	00	02	03	50	50	100	4
2	PEC	22MCM32X	Professional Elective -3	03	00	00	03	50	50	100	3
3	OEC	22MCM33X	Professional Elective -4	03	00	00	03	50	50	100	3
4	PROJ	22MCM34	Project Work Phase -1	00	06	00	--	100	--	100	3
5	SP	22MCM35	Societal Project	00	06	00	--	100	--	100	3
6	INT	22MCMI36	Internship	(06 weeks Internship Completed during the intervening vacation of II and III semesters.)			03	50	50	100	6
TOTAL				**09**	**12**	**03**	**12**	**400**	**200**	**600**	**22**

Note: PCC: Professional core courses, PEC: Professional Elective Courses, IPCC-Integrated Professional Core Courses. MPS-Mini Project with Seminar; AUD/AEC; Audit Courses / Ability Enhancement Courses (Mandatory), PCCL-Professional Core Course lab, **L-Lecture, P-Practical, T/SDA-Tutorial / Skill Development Activities** (Hours are for Interaction between faculty and students)

Professional Elective -3		**Professional Elective -4**	
Course Code under 22MCM32X	**Course title**	**Course Code under 22MCM33X**	**Course title**
22MCM321/CAE235	Industrial design and ergonomics	22MCM331	Cyber Security For Physical System
22MCM/CAE322	Networking and IoT	22MCM/MPM/MPT 332	Supply chain management
22MCM323	Tooling for Manufacture In Automation	22MCM333	**Virtual Instrumentation**
22MCM324	Operation Research	22MCM334	Electronics Manufacturing Technology
22MCM325	Reliability and Maintenance Engineering	22MCM335	Digital Image Processing & Machine Vision

Note:

1. Project Work Phase-1: The project work shall be carried out individually. However, in case a disciplinary or interdisciplinary project requires more participants, then a group consisting of not more than three shall be permitted.

Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall pursue a literature survey and complete the preliminary requirements of the selected Project work. Each student shall prepare a relevant introductory project document, and present a seminar.

CIE marks shall be awarded by a committee comprising of HoD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question-and-Answer session in the ratio of 50:25:25.

2. Societal Project: Students in consultation with the internal guide as well as with external guide (much preferable) shall involve in applying technology to workout/proposing viable solutions for societal problems.

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question-and-Answer session in the ratio of 50:25:25.

Those, who have not pursued /completed the Societal Project, shall be declared as fail in the course and have to complete the same during subsequent semester/s after satisfying the Societal Project requirements. There is no SEE (University examination) for this course.

3. Internship: Those, who have not pursued /completed the internship, shall be declared as fail in the internship course and have to

complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question-and-Answer session in the ratio of 50:25:25.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2022
M.Tech.,**Computer Integrated Manufacturing (MCM)**
Choice Based Credit System (CBCS) and Outcome-Based Education (OBE)

IV SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work	Duration in hours	CIE Marks	SEE Marks Viva voce	Total Marks	
				L	P					
1	Project	22MCM41	Project Work Phase -2	--	08	03	100	100	200	18
			TOTAL	--	**08**	**03**	**100**	**100**	**200**	**18**

Note:

1. Project Work Phase-2:

Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall continue to work of Project Work phase -1to complete the Project work. Each student / batch of students shall prepare project document, and present a seminar.

CIE marks shall be awarded by a committee comprising of HoD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question-and-Answer session in the ratio of 50:25:25.

SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the University norms.

Total Credits 22+18+22+18 =**80**

Semester - III

ARTIFICIAL INTELLIGENCEAND EXPERT SYSTEM IN AUTOMATION

Course Code	22MCM31	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	40 Hrs+ 10-12 Activities	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives:
To acquire knowledge on intelligent systems and agents, formalization of knowledge, reasoning with and without uncertainty, machine learning and applications at a basic level.

Module-1

Introduction: Artificial Intelligence in CAD, Applications of Artificial Intelligence in design. Scope and history of AI. Structure of an expert system, building an expert system. Strategies for knowledge acquisition, components of knowledge. Knowledge representation, production systems, decision tables, frame systems. 08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Knowledge Representations: knowledge representations process, purposes, contexts and agents, knowledge soup, knowledge acquisition and sharing. Knowledge representation languages, issues in knowledge representation. A network representation language. LISP: Introduction to LISP. Search strategies in LISP, a recursive unification function. Interpreters and embedded languages. Logic programming in LISP. An expert system shell in LISP. 08Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Decision Support Systems: introduction. Basis of decision making. Typical progressive models. Intelligent models, life-cycle values. Total life-cycle cost. Compatibility analysis. Sensitivity analysis. Life-cycle ranking or rating scheme. 08Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Learning Processes and AI Algorithms: the general problem solver and difference tables. Resolution theorem proving. Machine learning, perceptron learning, back propagation learning, and competitive learning. The genetic algorithm: the genetic programming. Artificial life and society based learning. Methods of inference, inexact reasoning. 08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Knowledge Based Design Aids: inference process, backward chaining, forward chaining, hybrid chaining. Expert system shells, feature based modelling, feature recognition, design by features, and application of feature based models. Design of expert systems and applications: benefits and examples of expert systems. Design of expert systems, introduction to clips, pattern matching, modular design and execution control fuzzy logic, typical expert system MYCIN, DENDRAL, PROSPECTOR. 08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

.

Suggested Learning Resources:

Books

(1) A guide to Expert Systems – Donald A Waterman, Addison Wesley, 1st edition, 2002.
(2) Principles of Artificial Intelligence – Springer-Verlag, Berlin, 1982.
(3) Introduction to Artificial Intelligence and Expert Systems – DAN.W.Patterson, PHI, 2nd edition, 2009.

Reference Books

(1) Understanding Decision Support System and Expert Systems-McGraw Hill, 2nd edition, 1993.
(2) Artificial Intelligence – Elain Rich, McGraw Hill, 3rd edition, 2010.
(3) Artificial Intelligence- George.F.Luger, Pearson Education, Asia, 3rd Edition,2009.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand problem solving methods, state space problems and search methods.	5
CO2	Understand knowledge acquisition and representation methods.	5
CO3	Apply knowledge on decision making	5
CO4	Assess critically the techniques presented and apply them to real world problems	5
CO5	Develop knowledge of decision making and learning methods.	4

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	3	3	2	2	1
CO2	3	3	3	3	2	1	2
CO3	3	3	2	1	2	3	3
CO4	3	3	2	2	3	3	2
CO5	3	3	2	1	2	3	3

INDUSTRIAL DESIGN & ERGONOMICS

Course Code	22MCM321/CAE235	CIE Marks	**50**
Teaching Hours/Week (L:P:SDA)	**3:0:0**	SEE Marks	**50**
Total Hours of Pedagogy	**40**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course Learning objectives: The course aims to provide an overview of ergonomics principles. A comprehensive view of ergonomics applied in various domains like industrial cognitive and interaction will be covered. The course will help in understanding the design aspects of ergonomics and their applications in real-world problems through case studies and studio sessions.

Module-1

Introduction: An approach to industrial design - elements of design structure for industrial design in engineering application in modem manufacturing systems. Ergonomics and Industrial Design: Introduction - general approach to the man-machine relationship- work station design-working position. **08HRs**

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Control and Displays: shapes and sizes of various controls and displays-multiple displays and control situations - design of major controls in automobiles, machine tools etc., - design of furniture - designof instruments. **08HRs**

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

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Ergonomics and Production: Ergonomics and product design ergonomics in automated systems- expert systems for ergonomic design, Anthropomorphic data and its applications in ergonomic design limitations of anthropomorphic data-use of computerized database**... . 08HRs**

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Visual Effects of Line and Form: The mechanics of seeing psychology of seeing, general influences of lined and form. Colour: colour and light - colour and objects - colour and the eye colour consistency - colour terms - reactions to colour and colour continuation - colour on engineering equipments. **08HRs**

8Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Aesthetic Concepts: Concept of unity - concept of order with variety - concept of purpose style and environment - Aesthetic expressions. Style-components of style - house style, observations style in capital goods. **Industrial Design in Practice:** General design - specifying design equipments - rating the importance of industrial design – industrial design in the design process. **08HRs**

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

(1)Industrial design for Engineers - Mayall W.H. - LondonCliffee Books Ltd.

(2)Applied Ergonomics Hand Book - Brien Shakel (Edited) - Butterworth Scientific,

Web links and Video Lectures (e-Resources):

- http://.ac.in/courses.php?disciplineID=111
- http://academicearth.org/
- http://www.bookstreet.in.
- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understanding the concepts of Industrial design and man-machine relationship.	
CO2	Design of optimistic display and control devices for various applications.	
CO3	Applying the anthropomorphic data in ergonomic design.	
CO4	Understanding the visual effects of lines, form and color on engineering equipments.	
CO5	Choosing appropriate aesthetic aspects for design of industrial machinery and evices.	

Program Outcome of this course
Programme Outcome:

PO1 - An ability to independently carry out research /investigation and development work to solve practical problems.

PO2 - An ability to write and present a substantial technical report/document.

PO3 - Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PO4 - Understand contemporary issues in management and develop relationship between engineering and management practices

PO5 – develop the understanding of various quantitative techniques and approaches to solve management problems

PO6 – ability to understand the techniques of marketing management and marketing research

PO7 –familiarization with roles and responsibilities of a manager in engineering practice

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	2	2	3	2	2
CO2	1	2	2	2	2	2	2
CO3	2	2	2	3	2	3	3
CO4	2	3	1	2	3	3	1
CO5	2	3	3	2	2	3	2

Professional Elective-3			
NETWORKING AND IOT			
Course Code	22MCM/CAE322	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs+10-12 Activity Sessions	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

1. Able to understand the application areas of IOT
2. Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
3. Able to understand building blocks of Internet of Things and characteristics.

Module-1	
Introduction to IoT Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models &APIs. IoT& M2M Machine to Machine, Difference between IoT and M2M, Softwaredefine Network 05 Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2	
Network & Communication aspects Wireless medium access issues, MAC protocol survey, Surveyrouting protocols, Sensor deployment & Node discovery, Data aggregation & dissemination. 05 Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3	
Challenges in IoT Design challenges, Development challenges, Security challenges,Other challenges. 05 Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4	
Domain specific applications of IoT Home automation, Industry applications, Surveillance applications,Other IoT applications. 05 Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5	
Developing IoTs Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python. 05 Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

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2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

.

Suggested Learning Resources:

Books

(1) IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things.by David Hanes,Cisco Press,2007

(2) Vijay Madisetti, ArshdeepBahga, "Internet of Things: A Hands-On Approach"

Reference Books

(3) (1) Computer Networks; By: Tanenbaum, Andrew S; Pearson Education Pte. Ltd., Delhi, 4th Edition 6

(2) WaltenegusDargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice

(3) Data and Computer Communications; By: Stallings, William; Pearson Education Pte. Ltd., Delhi, 6th Edition

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Interpret the design aspects and communication models of IoT.	5
CO2	Examine the design, development, security and deployment challenges pertaining to IoT.	4
CO3	Analyze the media access control protocols, routing protocols and node discovery strategies used in IOT	4
CO4	Explain the data dissemination and aggregation techniques used by IoT sensors.	5
CO5	Examine the domain specific IoT applications.	5

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**3**	**2**	**2**	**2**	**1**	**1**
CO2	**3**	**3**	**3**	**3**	**2**	**2**	**1**
CO3	**3**	**3**	**2**	**2**	**1**	**2**	**3**
CO4	**3**	**3**	**2**	**1**	**2**	**3**	**2**
CO5	**2**	**2**	**2**	**3**	**3**	**2**	**1**

Professional Elective-3			
TOOLING FOR MANUFACTURE IN AUTOMATION			
Course Code	22MCM323	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs+10-12 Activity Sessions	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

1. Describe the basic concepts of automation in manufacturing systems.
2. Acquire the fundamental concepts of automated flow lines and their analysis.

Module-1

Mechanics of Metal Cutting: Introduction, measurement of cutting force sand chip thickness, force components, chip formation and primary plastic deformation, shear plane and slip line theories for continuous chip formation.
ModernCuttingTool Materials: Material properties, HSS related materials, sintered tungsten carbide, cermets, ceramics, polycrystalline tools, tool coatings.
Cutting tools: Basic types of cutting tools, turning tools, index able inserts, groove geometry,edge preparation,wiper geometry, insert clamping methods, tool angles, threading tools, cutters.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Optimization: Machining costand production rate verses cutting speed,role of computerized optimization system, economic considerations, optimization of machining system.
Tooling Requirements for CNC Machines: Tool holding systems modular and quick change tool holding system, tool Holder spindle connection, cutting tool clamping systems, milling cutter driver, side lock type chuck, collet chucks, hydraulic chucks, milling chucks. Tool magazines, Automatic tool changers.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Location and Clamping Methods: Basic principles of locating, locating methods & devices, Basic principles of clamping, clamping methods.
Fixtures: Definitions, General considerations, Machine considerations, Process considerations, Product considerations, Types of fixtures, Vise fixtures, Milling fixtures.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Fixtures for Automation:Work holders for CNC, Fixturing in FMS: Part holding on Pallets, standard fixtures, pallet changers, palletpool, flexible fixturing – principles and methodologies, modular fixturing system: T slot based, dowel pin based, fixturing components.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Plastics for Tooling Materials: Introduction, Commonly used plastics for tooling, Epoxy plastic stools,Construction methods, Urethanedies, Force calculation for Urethane pressure pads.

05 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

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The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

.

Suggested Learning Resources:

Books

1. Cyrol Donaldson, Tool Design -,Tata McGrawHill, India.
2. Edward G Hoffman, Fundamentals of Tool Design-,SME,USA.
3. Joshi, P.H., Jigs & Fixtures, Second Edition,TataMcGraw-Hill,New,Delhi2004
4. Hiram E Grant, Jigs and Fixture Tata McGraw-Hill, New Delhi, 2003
5. G.R.Nagpal, Tool Engineering& Design-, Khanna publications
6. Dr. B.J. Ranganath, Metal cutting and tool design, Vikas publishing house
7. David A. Stephenson, John S. Agapiou, Metal cutting theory and practice, Second edition C RC taylor and Francis publishers.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Select the cutting tool according to requirements and component design.	5
CO2	Design the tooling requirement and customize the same for developing complex geometry components.	5
CO3	Explain basic principles of locating & clamping. Discuss General considerations in design of drill jigs.	4
CO4	Design flexible fixture for automation preprocess.	5
CO5	Demonstrate application of non-metal fixture.	5

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
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Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**3**	**3**	**2**	**2**	**2**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**2**	**2**
CO3	**3**	**3**	**3**	**3**	**3**	**2**	**2**
CO4	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO5	**2**	**2**	**2**	**2**	**2**	**2**	**1**

Professional Elective-3			
OPERATIONS RESEARCH			
Course Code	22MCM324	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
Operations research helps in solving problems in different environments that needs decisions. This includes: linear programming, Transportation, Assignment, and CPM/ MSPT techniques. Analytic techniques and computer packages will be used to solve problems facing business managers in decision environments.

Module-1

Optimization Techniques, Model Formulation, models, GeneralL.RFormulation, SimplexTechniques, SensitivityAnalysis, InventoryControlModels.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

FormulationofaLPP-Graphicalsolutionrevisedsimplexmethod–dualitytheory-dualsimplexmethod-sensitivity analysis-parametric programming

.08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Non linear programming problem-Kuhn-Tucker conditions min cost flow problem- max flow problem- CPM/PERT.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Scheduling and sequencing-single server and multiple server models-deterministic inventory models Probabilistic inventory control models–Geometric Programming.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

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The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
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4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

.

Suggested Learning Resources:

Books

- H. A.Taha,OperationsResearch,anIntroduction,PHI,2008
- H M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
- J C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
- Hitler Liebermann Operations Research: McGraw HillPub.2009
- Pannerselvam,OperationsResearch:PrenticeHallofIndia2010
- HarveyMWagner,PrinciplesofOperationsResearch:PrenticeHallofIndia2010

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand the meaning, definitions, scope, need, phases and techniques of operations research.	5
CO2	Formulate as L. P. P and derive optimal solutions to linear programming problems by graphical method, Simplex method, Big-M method and Dual Simplex method.	5
CO3	Construct network diagrams and determine critical path, floats for deterministic and PERT networks including crashing of Networks.	4
CO4	Determine minimum processing times for sequencing.	5
CO5	Solve problems on game theory for pure and mixed strategy under competitive environment.	5

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	2	3	3	2	1
CO2	3	3	3	2	1	2	2
CO3	3	3	3	2	1	2	2
CO4	3	3	3	2	1	2	2
CO5	3	3	2	1	2	3	2

Professional Elective-3

RELIABILITY AND MAINTENANCE ENGINEERING

Course Code	22MCM325	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Describe product development, conceptual design and classify rapid prototyping systems; explain stereo lithography process and applications
- Applying of measurement and scaling technique for prototype manufacturing.
- Identify The process photopolymers, photo polymerization, layering technology, laser and laser scanning

Module-1

Reliability Engineering: System reliability - series, parallel and mixed configuration, Block diagram, r-out-of-n structure, Solving problems using mathematical models. Reliability improvement and allocation - Difficulty in achieving reliability, Method of improving reliability during design, different techniques available to improve reliability, Reliability–Cost trade off, Prediction and analysis, Problems.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Maintainability, Availability & Failure Analysis: Introduction, Techniques available to improve maintain ability & availability, trade off among reliability, maintainability & availability and analysis. Defect generation – Types of failures, defects reporting and recording, Defect analysis, Failure analysis, Equipment down time analysis, Breakdown analysis, TA, FMEA, FMECA.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Maintenance Planning and Replacement: Maintenance planning – Overhaul and repair; Meaning and difference, Optimal overhaul/ Repair/ Replace maintenance policy for equipment subject to breakdown, Replacement decisions – Optimal interval between preventive replacements of equipment subject to breakdown, group replacement.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Maintenance Systems: Fixed time maintenance, Opportunity maintenance, design out maintenance, Total productive maintenance, Inspection decision – Optimal inspection frequency ,non – destructive inspection, PERT & CPM in maintenance, Concept of tero technology.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Mechanical Fault Diagnosis by Condition Monitoring Techniques: Thermography, Radiography, Ferrography,Acoustic emission monitoring, Noise monitoring.Online monitoring and diagnostic systems. Condition monitoring in power plants, chemical plants and petro chemical plants.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

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Semester End Examination:

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4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

.

Suggested Learning Resources:

Books

- Optimization theory & Applications / S. S. Rao / New Age International
- Introductory to operation research / Kasan & Kuma r/ Springar
- OptimizationTechniques theory & practice / M.CJoshi, K.M.Moudgalya / Narosa Publications.
- Operation Research / H.A.Taha / TMH
- Optimization in operations research / R. L Rardin.
- Optimization Techniques / Benugundu & Chandraputla / Person Asia.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Describe various methods of reliability to predict maintenance requirement and cost effectiveness.	
CO2	Predict and analyze the failure and maintenance requirement using various techniques	
CO3	Plan the schedule the maintenance with minimum break down time	
CO4	Apply various tool and techniques monitor the condition of the equipment	
CO5	Describe case studies related to condition monitoring of various manufacturing and process engineering systems.	

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
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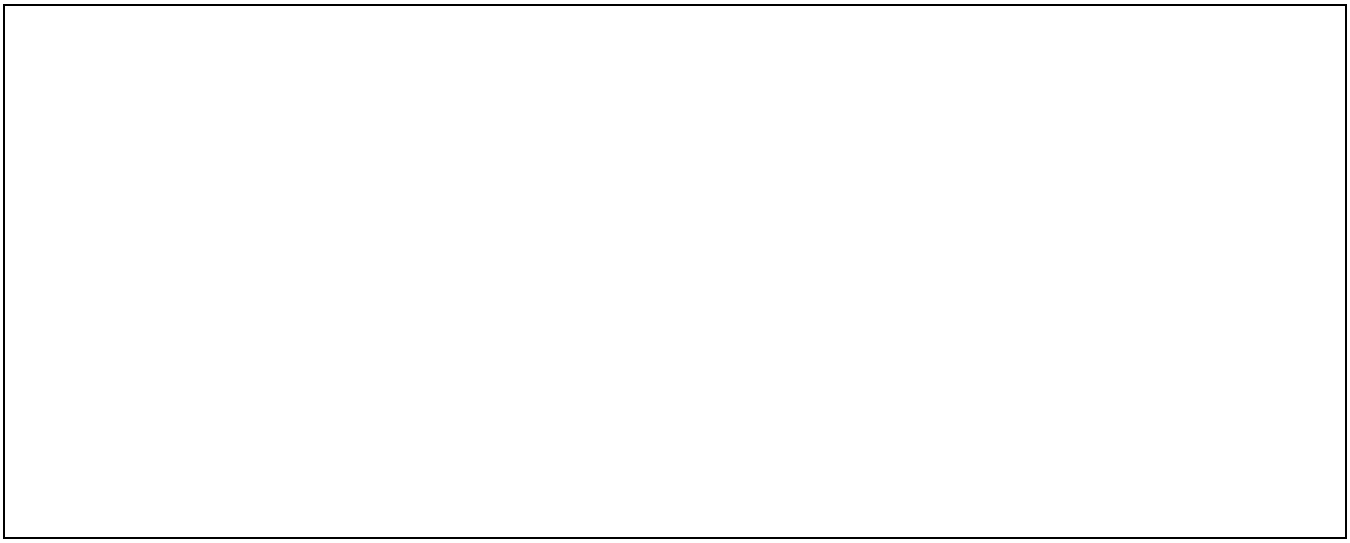
Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	3	2	2	3
CO2	3	3	2	2	1	2	1
CO3	3	3	3	3	2	1	2
CO4	3	3	2	2	2	2	2
CO5	2	2	2	3	3	3	2



Professional Elective -4			
CYBER SECURITY FOR PHYSICAL SYSTEM			
Course Code	22MCM331	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To introduce students to cyber-physical systems modeling, analysis, and design.

Module-1

Software and System Security : Control hijacking attacks – buffer overflow, integer overflow, bypassing browser memory protection; Sand boxing and Isolation; and techniques for writing robust application software; Security vulnerability detection tools, and techniques–program analysis (static, concolic and dynamic analysis); Privilege, Access control and Operating System Security; Exploitation techniques and Fuzzing.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Network Security & Web Security: SecurityIssuesinTCP/IP–TCP,DNS,Routing(Topicssuchasbasicproblemsof security in TCP/IP, IP sec, BGP Security, DNS Cache poisoning etc); Network Defense tools – Firewalls, Intrusion Detection, Filtering; DNS Sec, NSec3, distributed firewalls, intrusion detection tools: Threat Models, Denial of Service Attacks, DOS-proof network architecture; Security architecture of World Wide Web, security architecture of web servers, and Web Clients: Web Application Security – cross site scripting attacks, cross site request forgery, SQL Injection Attacks:

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Security in Mobile Platforms: Android vs. IoS security model, threat models, information tracking, root kits: Threats in mobile applications, analyser for mobile apps to discover security vulnerabilities; Viruses, spywares, and key logger sand malware detection.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Introduction to Hardware Security, Supply Chain Security: Threats of Hardware Trojans and Supply Chain Security; Side Channel Analysis based threats and attacks.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Issues in Critical Infrastructure and SCADA Security: Security issues in SCADA; IP Convergence Cyber Physical System Security threats: Threat models in SCADA and various protection approaches; Machine learning and SCADA Security.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

.

Suggested Learning Resources:

Books

1. Cyber security: Understanding cyber crime, phenomenon, challenges and legal response ITU Report, November 2014
2. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, By Nina Godbole and Sunit Belapure, Wiley India

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Demonstrate physical system security from the cyber attack	5
CO2	Demonstrate network and web security threat models and corrective modules	5
CO3	Demonstrate various mobile platforms discover security vulnerabilities	4
CO4	Understand and analyse the hardware security requirement	5
CO5	Describe the application of SCADA protection approaches	5

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	2	3	3
CO2	3	3	3	2	1	2	3
CO3	3	3	2	1	2	2	2
CO4	3	3	2	1	2	3	3
CO5	3	3	2	1	2	3	2

Professional Elective-3			
SUPPLY CHAINMANAGEMENT			
Course Code	22MCM/MPM/MPT332	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

1. To develop an understanding of basic concepts and role of Logistics and supply chain management in business.
2. To understand how supply chain drivers play an important role in redefining value chain excellence of Firms.

Module-1

Introduction: Definition of logistics and supply chain management, decision phases in a supply chain, objectives of SCM, examples of supply chains, supply chain drivers, supply chain integration, supply chain performance measures. Logistics Network Design: Role of distribution in supply chain, distribution network design, factors influencing distribution network design, distribution networks in practice, network design in the supply chain, factors influencing the network design, framework for network design, models for facility location and capacity allocation, Impact of uncertainty on network design

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Coordinated Product And Supply Chain Design: General framework - design for logistics - standardization – pushpull boundary - supplier integration into new product development - keys to effective supplier integration - mass customization - meaning - mass customization and supply chain management

.08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Strategic Alliances: Framework for strategic alliances - Third Party Logistics - 3PL issues and requirements - retailer -supplier partnerships - issues in retailer - supplier partnerships - distributor integration - types and issues of distributorintegration.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Inventory Management: Cycle inventory, economies of scale to exploit fixed costs, quantity discounts, example problems, multi-echelon inventory, safety inventory in supply chain, safety level estimation, supply uncertainty, data aggregation, replenishment policies, managing safety inventory in practice, product availability, optimal level, affecting factors, supply chain contracts - Bull whip effect.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Technologies For SCM: Information Technology (IT) - Infrastructure - Interface devices - System architecture - Electronic commerce - IT for supply chain excellence - Service oriented architecture - Radio Frequency Identification (RFID) - Impact of internet.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module
6. .

Suggested Learning Resources:

Books

(1) Simchi - Levi Davi, Kaminsky Philip and Simchi-Levi Edith, "Designing and Managing the Supply Chain", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2012.

(2) Sunil Chopra and Peter Meindl, "Supply Chain Management", Prentice Hall, New Jersey, 2010. (3) Sadler I, "Logistics and Supply Chain Integration", Sage Publishers, 2007.

(4) David J.Bloomberg , Stephen Lemay and Joe B.Hanna, "Logistics" PHI

Reference Books

(1) Jeremy F.Shapiro, "Modeling the Supply Chain", Thomson Duxbury

(2) Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management", PHI,

(3) James B.Ayers, "Handbook of Supply Chain Management", St.Lucle press

Web links and Video Lectures (e-Resources):

- .VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Demonstrate a clear understanding of the key concepts applied in logistics and supply chain management.	
CO2	To highlight the importance of all activities of the supply chain and an understanding of concepts like inbound and outbound logistics, offshore and inshore logistics.	
CO3	To develop skills for planning, designing the operational facilities of supply chain with the analytical and critical understanding	
CO4	Apply various tools and techniques to plan and maintain the inventory	
CO5	Demonstrate application information technology in SCM.	

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
PO4	To allow students to work in teams through group project works and thus help them achieve interpersonal and communication skills.	
PO5	To inculcate the habit of lifelong learning, adherence to ethics in profession, concern for environmental and regard for good professional practices.	
PO6	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO7	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	3	3	3	2	2
CO2	3	3	3	2	3	2	1
CO3	2	3	2	3	3	3	3
CO4	3	3	3	3	3	2	2
CO5	2	3	3	3	3	2	2

Professional Elective -4			
VIRTUAL INSTRUMENTATION			
Course Code	22MCM333	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

1. To provide knowledge on design of process control by using virtual instrumentation techniques.
2. To provide knowledge in process analysis by VI tools.
3. To give basic knowledge in describing function analysis.
4. Get adequate knowledge VI tool sets

Module-1

Virtual Instrumentation: An introduction

Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow and comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

VI programming techniques:

Vis and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Data acquisition basics:

Introduction to data acquisition on PC, Sampling fundamentals, Input / Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

VI Interface requirements:

Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Fire wire. PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

VI tool sets:

Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process data base management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing ,Motion control

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

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The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module
6. .

Suggested Learning Resources:

Books

- LabVIEWGraphicalProgramming, GaryJohnson, Secondedition, McGrawHill, Newyork, 1997.
- LabVIEWbasedAdvancedInstrumentationSystems, S.SumathiandP.Surekha, Spinger.
- PC Interfacing for Data Acquisition and Process Control Gupta S. and Gupta J.P Instrument society of America,1994
- PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Kevin James, Newnes, 2000.
- LabVIEWforeveryone, LisaK.wells&JeffreyTravisPrenticeHall, NewJersey, 1997.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Explain virtual instrument concepts.	4
CO2	Select proper data acquisition hardware and Configure data acquisition.	5
CO3	Familiarize the basics and interfacing of VI	3
CO4	Discuss operating systems required for virtual instrumentation.	5
CO5	Create virtual instruments for practical works	5

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
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Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	2	3	3
CO2	3	3	3	2	2	3	3
CO3	3	3	2	1	2	2	2
CO4	3	3	2	2	2	2	1
CO5	3	3	3	2	2	3	2

Professional Elective -4			
ELECTRONICS MANUFACTURING TECHNOLOGY			
Course Code	22MCM334	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

1. To understand wafer preparation and PCB fabrication, the types of Mounting Technologies and components for electronics assembly & SMT process in detail.
2. To know various Defects, Inspection Equipments SMT assembly process and repair, rework and quality aspects of Electronics assemblies.

Module-1

INTRODUCTION TO ELECTRONICS MANUFACTURING: History, definition, wafer preparation by growing, machining, and polishing, diffusion, microlithography, etching and cleaning, Printed circuit boards, types- single sided, double sided, multi layer and flexible printed circuit board, design, materials, manufacturing, inspection.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

COMPONENTS AND PACKAGING: Introduction to packaging, types-Through hole technology (THT) and Surface mount technology (SMT), Through hole components – axial, radial, multi leaded, odd form. Surfacemount components- active, passive. Interconnections - chip to lead interconnection, die bonding, wire bonding, TAB, flip chip, chip on board, multi chip module, direct chip array module, leaded, leadless, area array and embedded packaging, miniaturization and trends.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

SURFACE MOUNT TECHNOLOGY PROCESS: Introduction to the SMT Process, SMT equipment and material handling systems, handling of components and assemblies - moisture sensitivity and ESD, safety and precautions needed, IPC and other standards, stencil printing process - solder paste material, storage and handling, stencils and squeegees, process parameters, quality control. Component placement- equipment 89 type, flexibility, accuracy of placement, throughput, packaging of components for automated assembly, Cp and Cpk and process control..

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

INSPECTION AND TESTING: Inspection techniques, equipment and principle - AOI, X-ray. Defects and Corrective action - stencil printing process, component placement process, reflow soldering process, underfill and encapsulation process, electrical testing of PCB assemblies- In circuit test, functional testing, fixtures and jigs.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

REPAIR, REWORK, QUALITY AND RELIABILITY OF ELECTRONICS ASSEMBLIES: Repair tools, methods, rework criteria and process, thermo-mechanical effects and thermal management, Reliability fundamentals, reliability testing, failure analysis, design for manufacturability, assembly, rework ability, testing, reliability, and environment.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
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The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

.

Suggested Learning Resources:

Books

1. Prasad R., "Surface Mount Technology – Principles and practice", second Edition, Chapman and Hall, 1997, New York, ISBN 0-41-12921-3.
2. Tummala R.R., "Fundamentals of microsystem packaging", Mc -Graw Hill, 2001, ISBN 00- 71-37169-9.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO	Perform fabrication of PCBs and use of mounting technology for electronic assemblies. Perform quality inspection on the PCBs	5

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
PO2	To develop the students analytical skills to enable them to understand real world problems and formulate solutions.	
PO3	To impart basic education to students in the areas of Design Engineering, Manufacturing Engineering and Thermal Sciences that will enable them to take up higher studies in these areas.	
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Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	2	1	2
CO2	3	3	2	2	2	2	1
CO3	3	3	2	3	3	2	1
CO4	3	3	2	1	2	2	3
CO5	3	2	2	2	2	2	3

Professional Elective -4			
DIGITAL IMAGE PROCESSING & MACHINE VISION			
Course Code	22MCM335	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
To treat the 2D systems as an extension of 1D system design and discuss techniques specific to 2D systems.

Module-1

Introduction: Fundamentals of Image formation, components of image processing system, image sampling and quantization.
Image Enhancement in the spatial domain: Basicgray-level transformation, histogram processing, arithmetic and logic operators, basic spatial filtering, smoothing and sharpening spatial filters.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Image Restoration: A model of the image degradation/ restoration process, noise models, restoration in the presence of noise–only spatial filtering, Weiner filtering, constrained least squares filtering, geometric transforms; Introduction to The image enhance in frequency domain.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Morphological Image Processing: Preliminaries,dilation,erosion,openandclosing,basicmorphologicalgorithms, The Hit-or-Miss Transformation

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Image Segmentation: Detection of discontinuous, edge linking and boundary detection, thresholding, Hough Transform Line Detection and Linking, region–based segmentation.

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Machine vision: Introduction,definition,Activevisionsystem,Machinevisioncomponents,hardware"sandalgorithms, image function and characteristics, segmentation, data reduction, feature extraction, edge detection, image recognition and decisions, m/c learning, application of machine vision such as in inspection of parts, identification, industrial robot control, mobile robot application,

08 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

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1. Three Unit Tests each of **20 Marks**
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The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

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Semester End Examination:

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4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

.

Suggested Learning Resources:

Books

- Computer Vision: Algorithms and Applications, Richard Szeliski, 2010 Springer
- Digital Image Processing, Rafeal C. Gonzalez, Richard E. Woods, Second Edition, Pearson Education / PHI
- Digital Image Processing using Matlab, Rafeal C. Gonzalez, Richard E. Woods, Steven L. Eddins, Pearson
- Computer Vision- Amodern pproach by D. Forsyth and J.Ponce, Prentice Hall2. Robot Vision by B.K.P. Horn, McGraw-Hill.
- Image Processing, Analysis, and Machine Vision, Milan Sonka, Vaclav Hlavac and Roger Boyle, Second Edition, Thomson Learning.
  Introduction to Digital Image Processing with Matlab, Alasdair McAndrew, Thomson Course Technology

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Explain the fundamentals of digital image and its processing	5
CO2	Perform image enhancement techniques in spatial and frequency domain.	5
CO3	Apply the concept of image segmentation.	5
CO4	Understand and document needs for specific machine vision system	4
CO5	Develop machine vision system based on requirement	5

Program Outcome of this course

Sl. No.	Description	POs
PO1	To prepare students to meet the industrial requirements at global level competitiveness.	
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Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	3	3	2	2
CO2	3	2	2	1	2	3	2
CO3	2	2	2	3	2	1	3
CO4	3	3	2	2	1	2	3
CO5	3	2	2	1	2	2	3

PROJECTWORK PHASE–1			
Course Code	22MCM34	CIE Marks	100

Teaching Hours/Week (L:P:SDA)	0:6:0	SEE Marks	--
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	--

Course Learning objectives:

1. Supporting dependent learning.
2. Guide to select and utilized equate information from varied resources maintain in ethics.
3. Guidetoorganizethe workintheappropriatemannerandpresentinformation(acknowledgingthesources)clearly.
4. Developinteractive,communication,organisation,timemanagement,andpresentationskills.
5. Impartflexibilityandadaptability.
6. Inspireindependentandteamworking.
   Expandintellectualcapacity,credibility,judgement,intuition.
7. Adheretopunctuality,settingand meetingdeadlines.
8. Instilresponsibilitiestooneselfandothers.
9. Trainstudentstopresentthetopicofprojectworkinaseminarwithoutanyfear,faceaudienceconfidently,enhancecommunication skill,involveingroup discussiontopresentand exchangeideas.

Project Phase-1 Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize thetopic of the Project. Subsequently, the students shall collect the material required for the selected project, preparesynopsisandnarrate themethodologytocarry outtheprojectwork.

Seminar: Eachstudent,undertheguidanceofaFaculty,isrequiredto

- Presenttheseminarontheselectedprojectorallyand/orthroughpowerpointslides.
- Answerthequeriesandinvolveindebate/discussion.
- Submittwocopiesofthetypedreportwithalistofreferences.

Theparticipantsshalltakepartindiscussiontofoster friendlyandstimulatingenvironment inwhichthestudentsaremotivated toreachhighstandardsandbecome self-confident.

Courseoutcomes:

Attheend ofthecoursethestudent willbeableto:

- Demonstrateasoundtechnicalknowledgeoftheirselectedprojecttopic.
- Undertakeproblemidentification,formulation,andsolution.
- Designengineeringsolutionstocomplexproblemsutilisingasystemsapproach.
- Communicatewithengineers andthecommunityatlargeinwrittenanoralforms.

Demonstratethe knowledge, skillsandattitudesofaprofessionalengineer.

ContinuousInternalEvaluation

CIE marks for the project report (50 marks), seminar (30 marks) and question and answer (20 marks) shall be awarded(basedonthequalityofreportandpresentation skill,participationinthequestionandanswer sessionbythestudent)bythe committee constituted for the purpose by the Head of the Department. The committee shall consist of three facultyfromthe departmentwiththeseniormostactingasthe Chairperson.

SOCIETAL PROJECT			
Course Code	22MCM35	CIE Marks	100
Teaching Hours/Week (L:P:SDA)	0:6:0	SEE Marks	--
Total Hours of Pedagogy	--	Total Marks	100
Credits	03	Exam Hours	--

Course Learning objectives:

1. Tosupportindependentlearningandinnovativeattitude.
2. Toguidetoselectandutilizeadequateinformationfromvariedresourcesupholdingethics.
3. Toguidetoorganizetheworkin theappropriatemannerandpresentinformation(acknowledgingthesources)clearly.
4. Todevelopinteractive,communication,organisation,timemanagement,andpresentationskills.
5. Toimpart flexibilityandadaptability.
6. Toinspireindependentandteamworking.
7. Toexpandintellectualcapacity,credibility,judgement,intuition.
8. Toadheretopunctuality,settingandmeetingdeadlines.
9. Toinstilresponsibilitiestooneselfandothers.
10. Totrainstudentstopresentthetopicofprojectworkinaseminarwithoutanyfear,faceaudienceconfidently,enhancecommunication skill,involveingroup discussiontopresentand exchangeideas.

Societal-Project: Eachstudentoftheprojectbatchshallinvolveincarryingouttheprojectworkjointlyinconstant consultationwithinternalguide,co-guide,andexternalguideandpreparetheprojectreportasperthenormsavoidingplagiarism.

Courseoutcomes:

Attheend ofthecoursethestudent willbeableto:

- Presentthe societal -projectandbeabletodefendit.
- Makelinks across different areas ofknowledgeandtogenerate,developandevaluateideas andinformationsoastoapplythese skillstothe projecttask.
- Habituatedtocriticalthinkinganduseproblemsolvingskills.
- Communicateeffectivelyandtopresentideasclearlyandcoherentlyinboththewrittenandoralforms.
- Workinateamto achievecommongoal.

Learnontheirown,reflectontheirlearningandtakeappropriateactionstoimproveit.

CIEprocedurefor Societal - Project:

TheCIEmarks awardedforMini-Project,shallbebasedon theevaluationof Societal- ProjectReport,ProjectPresentation skill and Question and Answer session in the ratio 50:25:25.The marks awarded for Societal - Project reportshallbe the same for all the batchmates.

INTERNSHIP			
Course Code	22MCMI36	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	(06 weeks Internship,To be Completed during the intervening vacation of II and III semesters.)	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	06	Exam Hours	03

Course Learning objectives:

Internship/Professional practice provide students the opportunity of hands-on experiencethatincludepersonaltraining, timeandstress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,

1. Toputtheoryinto practice.
2. Toexpandthinkingandbroadentheknowledgeandskillsacquiredthroughcourseworkint hefield.Torelate to,interactwith,andlearnfromcurrentprofessionalsinthe field.
3. Togainagreaterunderstandingofthedutiesandresponsibilitiesofaprof essional.Tounderstand andadheretoprofessionalstandardsinthe field.
4. Togaininsighttoprofessionalcommunicationincludingmeetings,memos,reading,writing,publicspeaking,research,clienti nteraction,inputofideas, andconfidentiality.
5. Toidentifypersonalstrengthsand weaknesses.
6. Todeveloptheinitiativeandmotivationtobeaself-starterandworkindependently.

Internship/Professionalpractice: Studentsundertheguidanceofinternalguide/sandexternalguideshalltakepartinalltheactiviti esregularlyto acquireas much knowledgeaspossiblewithoutcausinganyinconvenienceattheplaceofinternship.

Seminar: Eachstudent,isrequiredto

- Presenttheseminarontheinternshiporallyand/orthroughpowerpointslides.
- Answerthequeriesandinvolveindebate/discussion.
- Submitthereportdulycertified bytheexternalguide.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivatedto reachhighstandardsandbecomeself-confident.

Courseoutcomes:

Attheend ofthecoursethestudent willbeableto:

- Gainpracticalexperiencewithinindustryin whichtheinternshipisdone.
- Acquireknowledgeoftheindustryinwhichtheinternshipisdone.
- Applyknowledgeandskillslearnedtoclassroomwork.
- Developagreaterunderstandingaboutcareeroptions whilemoreclearlydefiningpersonal careergoals.
- Experiencetheactivitiesandfunctionsofprofessionals.
- Developandrefineoralandwrittencommunicationskills.
- Identifyareasforfutureknowledgeandskilldevelopment.
- Expandintellectualcapacity,credibility,judgment,intuition.

ContinuousInternalEvaluation

CIE marks for the Internship/Professional practice report (20 marks), seminar (20 marks) and question and answer session (10marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session bythe student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of threefacultyfromthe departmentwiththe seniormostactingasthe Chairperson.

SemesterEndExamination

SEE marks for the internship report (20 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded(based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointedbythe University.

PROJECTWORKPHASE-2			
Course Code	22MCM41	CIE Marks	100
Teaching Hours/Week (L:P:SDA)	0:0:8	SEE Marks	100
Total Hours of Pedagogy	--	Total Marks	200
Credits	18	Exam Hours	03

Course objectives:

1. To support independent learning.
2. To guide to select and utilize adequate information from varied resources maintaining ethics.
3. To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
4. To develop interactive, communication, organization, time management, and presentation skills.
5. To impart flexibility and adaptability.
6. To inspire in dependent and team working.
7. To expand intellectual capacity, credibility, judgement, intuition.
8. To adhere to punctuality, setting and meeting deadlines.
9. To instill responsibilities to oneself and others.
10. To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly inconstant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

At the end of the course the student will be able to:

- Present the project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills.
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflection their learning and take appropriate actions to improve it.

Continuous Internal Evaluation:

Project Report : 50 marks. The basis for awarding the marks shall be the involvement of the student in the project and in the preparation of project report. To be awarded by the internal guide in consultation with external guide if any.

Project Presentation : 30marks.

The Project Presentation marks of the Project Work Phase -II shall be awarded by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Question and Answer: 20marks.

The student shall be evaluated based on the ability in the Question and Answer session.

Semester End Examination

SEE marks for the project report (50 marks), seminar (30 marks) and question and answer session (20 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.