VII SEMESTER

Computer Aided Design and Manufacturing		Semester	VII
Course Code	**BMM701**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

- Provide exposure to CAD/CAM and CNC machines, and how to use them.
- Help students develop a general understanding of CAD/CAM concepts.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
- Chalk and Talk method for Problem Solving.
- Adopt flipped classroom teaching method.
- Adopt collaborative (Group Learning) learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.

MODULE-1 **8 Hours**

Fundamentals of CAD: Introduction to CAD/CAM, Historical Development, Industrial Look at CAD/CAM, Application of computers in design, Creating manufacturing database, Benefits of CAD. Computer Hardware, Graphic input devices, display devices, Graphics output devices, Central processing unit (CPU).

MODULE-2 **8 Hours**

Geometric transformations: 2D and 3D; transformations of geometric models like translation, scaling, rotation, reflection, shear; homogeneous representations, concatenated representation; Orthographic projections, Numerical Problems

MODULE-3 **8 Hours**

Flexible Manufacturing: Introduction, FMS components, Flexibility in Manufacturing – machine, Product, Routing, Operation, types of FMS, FMS layouts, FMS planning and control issues, deadlock in FMS, FMS benefits and applications

MODULE-4 **8 Hours**

Process Planning: Introduction, Manual process planning, Computer aided process planning – variant, generative, Decision logic decision tables, decision trees, Introduction to Artificial intelligence.

MODULE-5 **8 Hours**

CNC Basics and Part Programming: Introduction, Historical Background, Basic Components of an NC, Steps in NC, Verifications of Numerical control machine tool programs, Classification of NC Machine tool, Basics of motion control and feedback for NC M/C, NC part programming, Part programming methods, Modern Machining system, Automatically programmed tools, DNC, Adaptive control.

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

Sl.NO	Experiments
1	Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
2	Geometric Transformation algorithm experiment for translation/ rotation/ scaling: Writing and validation of computer program
3	Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC Machine.
4	Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine.
5	Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine.
6	Numerical differentiation or numerical integration experiment: Writing and validation of computer program.
7	NC code generation for grooving and thread cutting operation using cadem software
8	NC code generation for mirroring and pocket milling operation using cadem software
9	Experiment on Robot and programs
10	To study the characteristic features of CNC machine.

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

- Understand the Automation, CIM, CAD, CAM and explain the differences between these concepts
- Explain the use of different computer applications in manufacturing, and
- Prepare part programs for simple jobs on CNC machine tools and robot

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 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 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 the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated

including viva-voce and marks shall be awarded on the same day.

- 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 **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

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 have ten questions. Each question is set for 20 marks.
2. 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.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

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 may include questions from the practical component.

Suggested Learning Resources:

Books

- CAD / CAM Principles and Applications P N Rao Tata McGraw-Hill 3rd Edition, 2015
- CAD/CAM/CIM Dr. P. Radhakrishnan New Age International Publishers, New Delhi. 3rd edition
- CAD/CAM" Ibrahim Zeid Tata McGraw Hill.
- Principles of Computer Integrated Manufacturing S.KantVajpayee , Prentice Hall of India, New Delhi. 1999

Web links and Video Lectures (e-Resources):

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

Artificial Intelligence and Machine Learning		Semester	VII
Course Code	**BMM702**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

- Explain Artificial Intelligence and Machine Learning
- Illustrate AI and ML algorithm and their use in appropriate applications

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
- Chalk and Talk method for Problem Solving.
- Adopt flipped classroom teaching method.
- Adopt collaborative (Group Learning) learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.

MODULE-1 **8 Hours**

What is artificial intelligence?. Problems, problem spaces and search, Heuristic search techniques

MODULE-2 **8 Hours**

Knowledge representation issues, Predicate logic, Representation knowledge using rules. Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Candidate Elimination Algorithm, Inductive bias of Candidate Elimination Algorithm

MODULE-3 **8 Hours**

Decision Tree Learning: Introduction, Decision tree representation, Appropriate problems, ID3 algorithm.

Artificial Neural Network: Introduction, NN representation, Appropriate problems, Perceptrons, Backpropagation algorithm.

MODULE-4 **8 Hours**

Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting, MDL Principle, Bates optimal classifier, Gibbs algorithm, Navie Bayes classifier, BBN, EM Algorithm

MODULE-5 **8 Hours**

Instance-Base Learning: Introduction, k-Nearest Neighbour Learning, Locally weighted regression, Radial basis function, Case-Based reasoning.

Reinforcement Learning: Introduction, The learning task, Q-Learning

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

Sl.NO	Experiments
1	Implement A* Search algorithm.
2	Implement AO* Search algorithm.
3	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
4	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
5	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
6	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
7	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program
8	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
9	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs

Course outcomes (Course Skill Set):

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

- Appraise the theory of Artificial intelligence and Machine Learning.
- Illustrate the working of AI and ML Algorithms.
- Demonstrate the applications of AI and ML.

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 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 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 the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.

- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- 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 **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

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 have ten questions. Each question is set for 20 marks.
2. 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.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

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 may include questions from the practical component.

Suggested Learning Resources:

Books

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Machine Learning	TomM Mitchell	McGrawHill Education	1st Edn 2017
2	Artificial Intelligence	ElaineRich,KevinK and S B Nair	McGrawHill Education	3rd Edn, 2017
Reference Books				
1	Artificial Intelligence	Saroj Kaushik	Cengage learning	
2	Artificial Intelligence: A Modern Approach	Stuart Rusell, Peter Norving	Pearson Education	2ndEdition
3	Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems	AurÈlienGÈron	Shroff/O'Reilly Media	1st Edition,2017
4	The Elements of Statistical Learning	Trevor Hastie, Robert Tibshirani, Jerome Friedman, h	Springer series	2nd edition
5	Introduction to machine learning	Ethem Alpaydın	MIT Press	2nd edition

Web links and Video Lectures (e-Resources):

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

Mechatronics		Semester	VII
Course Code	**BMM703**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	4:0:0:0	SEE Marks	50
Total Hours of Pedagogy	52 hours Theory	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

- To acquire a strong foundation in science and focus in mechanical, electronics, control, software, and computer
  engineering, and a solid command of the newest technologies.
- To understand the evolution and development of Mechatronics as a discipline.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
- Chalk and Talk method for Problem Solving.
- Adopt flipped classroom teaching method.
- Adopt collaborative (Group Learning) learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.

MODULE-1

Introduction: Scope and elements of mechatronics, mechatronics design process, measurement system, requirements and types of control systems, feedback principle, Basic elements of feedback control systems, Classification of control system. Examples of Mechatronics Systems such as Automatic Car Park system, Engine management system, Antilock braking system (ABS) control, Automatic washing machine.

MODULE-2

Transducers and sensors: Definition and classification of transducers, Difference between transducer and sensor, Definition and classification of sensors, Principle of working and applications of light sensors, Potentiometers, LVDT, Capacitance sensors, force and pressure sensors, Strain gauges, temperature sensors, proximity switches and Hall Effect sensors.

MODULE-3

Signal Conditioning: Introduction – Hardware – Digital I/O, Analog to digital conversions, resolution, Filtering Noise using passive components – Registers, capacitors, amplifying signals using OP amps. Digital Signal Processing – Digital to Analog conversion, Low pass, high pass, notch filtering. Data acquisition systems (DAQS), data loggers, Supervisory control and data acquisition (SCADA), Communication methods.

MODULE-4

Microprocessor & Microcontrollers: Introduction, Microprocessor systems, Basic elements of control systems, Microcontrollers, Difference between Microprocessor and Microcontrollers.

MODULE-5

Mechatronics in Computer Numerical Control (CNC) machines: Design of modern CNC machines – Machine Elements: Different types of guide ways, Linear Motion guideways. Bearings: anti-friction bearings, hydrostatic bearing and hydrodynamic bearing. Re-circulating ball screws. Typical elements of open and closed loop control systems. Adaptive controllers for machine tools.

Course outcomes (Course Skill Set):

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

- Assess various control systems used in automation.
- Design and conduct experiments to evaluate the performance of a mechatronics system or component with
  respect to specifications, as well as to analyse and interpret data.
- Apply the principles of Mechatronics design to product design.

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 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- The CIE is the sum of Average of Two Internal Assessment Tests each of 25 marks and Any two Assessment methods for 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assessment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment for a total of 50 marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

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

- The question paper will have ten questions. Each question is set for 20 marks.
- 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.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Mechatronics-Principles Concepts and Applications Nitaigour Premchand Mahalik Tata McGraw Hill 1stEdition, 2003
2. Mechatronics–Electronic Control Systems in Mechanical and Electrical Engineering, W.Bolton Pearson Education 1st Edition, 2005

Reference Books

1. Mechatronics HMT Ltd Tata Mc Graw Hill 1st Edition, 2000 ISBN:978007 4636435
2. Mechatronics: Integrated Mechanical Electronic Systems K.P. Ramachandran, G.K. Vijayaraghavan, M.S. Balasundaram. Wiley India Pvt. Ltd. New Delhi 2008

Web links and Video Lectures (e-Resources):

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

Product Design and Development		Semester	VII
Course Code	**BMM714A**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:
To prepare students to excel in new product design and development through application of knowledge andpractical skills.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
- Chalk and Talk method for Problem Solving.
- Adopt flipped classroom teaching method.
- Adopt collaborative (Group Learning) learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.

Module-1 **8 Hours**

Introduction: Characteristics of successful product development, Design and development of products, duration and costof product development, the challenges of product development.

Development Processes and Organizations: A generic development process, concept development: the front-endprocess, adopting the generic product development process, the AMF development process, product development organizations, the AMF organization.

Module-2 **8 Hours**

Product Planning:
The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing,complete pre project planning, reflect all the results and the process.

Module-3 **8 Hours**

Identifying Customer Needs:
Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process.
Product Specifications: What arespecifications, when are specifications established, establishing target specifications, setting the final specifications.
Concept Generation: The activity of concept generation, clarifies the problem, search externally, search internally, exploresystematically, reflect on the results and the process.

Module-4 **8 Hours**

Concept Selection: Overview of methodology, concept screening, and concept scoring,

Concept Testing: Define the purpose of concept test, choose a survey population, choose a survey format, communicatethe concept, measure customer response, interpret the result, reflect on the results and the process.

Module-5 **8 Hours**

Product Architecture: What is product architecture, implications of the architecture, establishing the architecture, varietyand supply chain considerations, platform planning, related system level design issues.

Course outcome (Course Skill Set)

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

- To provide students with a solid foundation in mathematical modeling of engineering problems required forbringing new products fast into the market.

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 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- The CIE is the sum of Average of Two Internal Assessment Tests each of 25 marks and Any two Assessment methods for 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assessment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment for a total of 50 marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

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 have ten questions. Each question is set for 20 marks.
2. 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.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Book:

- Product Design and Development - Karl.T.Ulrich, Steven D Eppinger - Irwin McGrawHill - 2000.

Reference books:

- Product Design and Manufacturing - A C Chitale and R C Gupta, PH1, - 3rd Edition, 2003.
- New Product Development - Timjones. Butterworth Heinmann -Oxford. UCI -1997
- Product Design for Manufacture and Assembly - GeofferyBoothroyd, Peter Dewhurst and Winston Knight - 2002

Web links and Video Lectures (e-Resources):

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

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Lean Manufacturing		Semester	VII
Course Code	**BMM714B**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:
To prepare students to excel in new product design and development through application of knowledge andpractical skills.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
- Chalk and Talk method for Problem Solving.
- Adopt flipped classroom teaching method.
- Adopt collaborative (Group Learning) learning in the class
- Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.

Module-1 **8 Hours**

Framework of Toyota Production System: Just in time production system. JIT Logic -Pull system Japanese approach toproduction elimination of waste - JIT implementation requirements JIT application for job shops, Case studies.

Adaptable Kanban System: Kanban rules, supplier Kanban and sequence schedule used by supplier, Monthlyinformation & daily information.

Module-2 **8 Hours**

The rise of mass production: The rise & fall of Mass Production Mass production, work force, organization, tools, product –logical limits of Mass production, Sloan as a necessary compliment to Ford. Case study:- Rouge Production Plant.

The rise of lean production: - Birth place, concrete example, company as community, Final assembly plant, product development and engineering.

Module-3 **8 Hours**

Reduction of setup times- Concepts and Techniques: Setup Concepts, practical procedures for reducing setup time. **Standardization of operations:** Machine layout, multi-function workers and job rotation. Improvement activities toreduce work force and increase worker morale -foundation for improvements

Text Book 1 : Chapter 8, Chapter 9, Chapter 10, Chapter 11, Chapter 12

Additional Interests: Use any lean Six Sigma Statistical Analysis tool and learn to analyze data using 7QC tools.

Module-4 **8 Hours**

House of Lean -5S's and Waste Walks, Visual Management, Value Stream Mapping-Understanding the current state anddesigning the future state

Managing lean enterprise: - Finance, Career ladders, geographic spread and advantages of global enterprise. **Additional**
Interests: Develop VSM Current and Future state diagram using Microsoft Visio or Similar Software Package.

Module-5 **8 Hours**

Six sigma concepts: History, definitions, Statistical definitions, quality levels, Technical aspects, Six sigma for all: benefits to organizations, customers, suppliers and employers, Design for Six Sigma, DMAIC principles, DMADV principles, merits and demerits.

Course outcome (Course Skill Set)

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

- Identify how a production line can be run efficiently
- Reflect upon the critical skills and evaluate their own performance
- Relate concepts such as 'Just in Time manufacturing' and 'Lean manufacturing to the context of an assembly line.

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 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- The CIE is the sum of Average of Two Internal Assessment Tests each of 25 marks and Any two Assessment methods for 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assessment methods mentioned in the 22OB4.2, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment for a total of 50 marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

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 have ten questions. Each question is set for 20 marks.
2. 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.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Book:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition andYear
1.	Toyota Production System -An integrated approach to Just in Time	Yasuhiro Monden	- Engineering aild Management Press - Institute ofIndustrial Engineers	1983
2.	The Machine that changed the World. The Story of Lean 100 Production	James P Womack, Daniel T Jones, and Daniel Roos	Harper Perennial editionpublished	1991

3.	Gemba Kaizen: A Commonsense Approach to aContinuous Improvement Strategy	Masaaki Imai	Second Edition Hardcover	2012
4.	Value Stream Mapping : How to Visualize Work and Align Leadership for Organizational Transformation	Karen Martin , Mike Osterling		2016
5.	The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer	Jeffrey K. Liker	Toyota	

Web links and Video Lectures (e-Resources):

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

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Total Quality Management		Semester	VII
Course Code	BMM714C	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:
To prepare students to excel in new product design and development through application of knowledge andpractical skills.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
- Chalk and Talk method for Problem Solving.
- Adopt flipped classroom teaching method.
- Adopt collaborative (Group Learning) learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.

Module-1 **8 Hours**

Principles and Practice:

- Definition, basic approach, gurus of TQM, TQM Framework, awareness, defining quality, historical review, obstacles, benefits of TQM.
- Quality Management Systems: Introduction, benefits of ISO registration, ISO 9000 series of standards, ISO 9001 requirements.

Module-2 **8 Hours**

Leadership:

- Definition, characteristics of quality leaders, leadership concept, characteristics of effective people, ethics, the Deming philosophy,
- Role of TQM leaders, implementation, core values, concepts and framework, strategic planning communication, decision making,

Module-3 **8 Hours**

Customer Satisfaction and Customer Involvement:

- Customer Satisfaction: customer and customer perception of quality, feedback, using customer complaints, service quality, translating needs into requirements, customer retention, case studies.
- Employee Involvement – Motivation, employee surveys, empowerment, teams, suggestion system, recognition and reward, gain sharing, performance appraisal, unions and employee involvement, case studies.

Module-4 **8 Hours**

Continuous Process Improvement:

- The Juran trilogy, improvement strategies, types of problems, the PDSA Cycle, problem-solving methods, Kaizen, reengineering, six sigma, case studies.
- Statistical Process Control: Pareto diagram, process flow diagram, cause and effect diagram, check sheets, histograms, statistical fundamentals, Control charts, state of control, out of control process, control charts for variables, control charts for attributes, scatter diagrams, case studies.

Module-5 **8 Hours**

Total Productive Maintenance (TPM):

- Definition, Types of Maintenance, Steps in introduction of TPM in an organization, Pillars of TPM – 5S, Jishu Hozen, Quality Maintenance, Planned Maintenance.
- Quality by Design (QbD): Definition, Key components of QbD, Role of QbD in Pharmaceutical Industry, Benefits and Challenges of QbD. Environmental Management Systems (EMS): Definition, Basic EMS, EMS under ISO 14001, Costs and Benefits of EMS.

Course outcome (Course Skill Set)

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

CO1: Explain the various approaches of TQM

CO2: Infer the customer perception of quality

CO3: Analyse customer needs and perceptions to design feedback systems.

CO4: Apply statistical tools for continuous improvement of systems

CO5: Apply the tools and technique for effective implementation of TQM.

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 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- The CIE is the sum of Average of Two Internal Assessment Tests each of 25 marks and Any two Assessment methods for 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assessment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment for a total of 50 marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

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 have ten questions. Each question is set for 20 marks.
2. 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.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Total Quality Management Dale H. Besterfield Pearson Education India, Edition 03. ISBN: 8129702606,
2. Total Quality Management for Engineers M. Zairi Wood head Publishing ISBN:185573024
3. Managing for Quality and Performance Excellence James R. Evans and William M Lindsay Cengage Learning. 9th edition
4. Four revolutions in management Shoji Shiba, Alan Graham, David Walden Oregon 1990
5. Organizational Excellence through TQM H. Lal New age Publications 200864 Engineering Optimization Methods and Applications A Ravindran, K, M. Ragsdell Willey India Private Limited 2nd Edition,2006
6. Introduction to Operations Research- Concepts and Cases F.S. Hillier. G.J. Lieberman Tata McGraw Hill 9th Edition, 2010

Web links and Video Lectures (e-Resources):

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

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Non-Conventional Energy sources		Semester	VII
Course Code	**BMM755A**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

- To introduce the concepts and principles of solar energy, its radiation, collection, storage and application.
- To understand application aspects of Wind, Biomass, Geothermal, hydroelectric and Ocean energy.
- To examine energy sources and systems, including fossil fuels and nuclear energy, and then focus on other forms of alternate energy sources.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
- Chalk and Talk method for Problem Solving.
- Adopt flipped classroom teaching method.
- Adopt collaborative (Group Learning) learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.

Module-1 **8 Hours**

Introduction: Energy sources (including fossil fuels and nuclear energy), India's production and reserves of commercial energy sources, need for nonconventional energy sources, energy alternatives, Indian and global energy scenario.

Solar Radiation & Measurement: Extra-Terrestrial radiation, spectral distribution of extra-terrestrial radiation, solar constant, solar radiation at the earth's surface, beam, diffuse and global radiation, solar radiation data.

Pyrometer, shading ring Pyrheliometer, sunshine recorder, schematic diagrams, and principle of working, actinometer and bolometer.

Module-2 **8 Hours**

Solar Radiation Geometry: Flux on a plane surface, latitude, declination angle, surface azimuth angle, hour angle, zenith angle, solar altitude angle, expressions for the angle between the incident beam and the normal to a plane surface (No derivation) local apparent time, apparent motion of sun, day length, numerical problems.

Solar Thermal Systems: Flat plate collector, Evacuated Tubular Collector, Solar air collector, Solar concentrator, Solar distillation, Solar cooker, Thermal energy storage systems, Solar Pond, Solar Chimney (Tower).

Module-3 **8 Hours**

Energy from Biomass: Energy plantation, biogas production from organic wastes by anaerobic fermentation, description of bio-gas plants, transportation of biogas, problems associated with bio-gas production, application of biogas, application of biogas in engines, cogeneration plant, advantages & disadvantages.

Module-4 **8 Hours**

Hydroelectric plants: Advantages & disadvantages of waterpower, Hydrographs and flow duration curves numerical, Storage and pondage, General layout of hydel power plants- components such as Penstock, surge tanks, spill way and draft tube and their applications, pumped storage plants, Detailed classification of

hydroelectric plants. Tidal Power: Tides and waves as energy suppliers and their mechanics, fundamental characteristics of tidal power, harnessing tidal energy, limitations of tidal energy.

Module-5 **8 Hours**

Geothermal energy: Introduction, Principle of working, types of geothermal stations with schematic diagram Estimates of Geothermal Power, Nature of geothermal fields, Geothermal resources, Hydrothermal, Resources Geo pressured resources, Hot dry rock resources of Petro-thermal systems, Magma Resources-Interconnection of geothermal fossil systems, Advantages, and disadvantages of geothermal energy over other energy forms, Geothermal stations in the world.

Course outcome (Course Skill Set)

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

- Describe the various forms of non-conventional energy resources.
- Apply the fundamental knowledge of mechanical engineering to design various renewable energy systems
- Analyze the implications of renewable energy forms for selecting an appropriate system for a specific application

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 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- The CIE is the sum of Average of Two Internal Assessment Tests each of 25 marks and Any two Assessment methods for 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assessment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment for a total of 50 marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

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 have ten questions. Each question is set for 20 marks.
2. 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.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Solar Energy Principles, Thermal Collection &Storage, S.P.Sukhatme: Tata McGraw Hill Pub., NewDelhi.
2. Non-Conventional Energy Sources, G.D.Rai, NewDelhi.
3. Renewable Energy, power for a sustainable future, Godfrey Boyle,2004,
4. The Generation of electricity by wind, E.W.Golding.

5. Non-Conventional Energy Resources by B.H. Khan, Tata McGraw Hill Pub.,2009.

Reference Books

1. Fundamentals of Renewable Energy Resources by G.N.Tiwari, M.K.Ghosal, Narosa Pub., 2007.
2.Non-Conventional Energy Resources by B.H. Khan, Tata McGraw Hill Pub., 2009.
3. Non-Conventional Energy Resources by Shobh Nath Singh, Pearson India., 2016

Web links and Video Lectures (e-Resources):

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

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Statistical Quality Control		Semester	VII
Course Code	**BMM755B**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

- Statistical process control is to reduce variation in the output to achieve higher quality and lower costs.
- To help students understand the concepts underlying statistical quality control and to develop their ability to apply those concepts to the design and management of quality control processes in industries.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
- Chalk and Talk method for Problem Solving.
- Adopt flipped classroom teaching method.
- Adopt collaborative (Group Learning) learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.

Module-1	**8 Hours**
The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management (quality philosophy, links between quality and productivity, quality costs, legal aspects of quality implementing, quality improvement).	
Module-2	**8 Hours**
Modelling Process Quality: Mean, Median, Mode, Standard deviation, Calculating area, The Deming funnel experiment, Normal distribution tables, Finding the Z score, Central limit theorem.	
Module-3	**8 Hours**
Methods And Philosophy Of Statistical Process Control: Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length-ARL)	
Module-4	**8 Hours**
Process Capability: The foundation of process capability, Natural Tolerance limits, cp – process capability index, cpk, pp – process performance index, summary of process measures. Numerical problems	
Module-5	**8 Hours**
Control Charts For Attributes: Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, Control Charts for Nonconformities or Defects, Control Chart for Number of non conformities per unit. Numerical problems	

Course outcome (Course Skill Set)

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

- Students learn how to analyze quality data using statistical methods, and how to develop charting techniques.

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 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 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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- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment for a total of 50 marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

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 have ten questions. Each question is set for 20 marks.
2. 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.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

- **Introduction To Statistical Quality Control By** Douglas C. Montgomery Arizona State University

Web links and Video Lectures (e-Resources):

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

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