Engineering Thermodynamics		Semester	III
Course Code	BMM301	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	03
Examination type (SEE)	Theory		

Course objectives:

- Learn about thermodynamic system and its equilibrium, Understand various forms of energy - work and heat transfer
- Study the basic laws of thermodynamics including, zeroth law, first law and second law
- To understand the applications of the first and second laws of Thermodynamics to various gas processes and cycles.
- To study the Carnot Cycle and the concept of Entropy
- To understand the various Air standard and Vapor power cycles and their Performance.
- To understand the concepts related to Refrigeration and Air conditioning.
- To get conversant with Psychrometric Charts, Psychrometric processes, human comfort conditions

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 **08 Hours**

Introduction: Role of Thermodynamics in Engineering and Science, Applications of Thermodynamics

Basic Definitions: Thermodynamic System and Control Volume, Surroundings. Macroscopic and Microscopic Analysis. Definition of Substance, Properties of Substance, Intensive and Extensive, Mathematical Representation of Property, State of substance. Thermodynamic Equilibrium, Concept of Quasi Equilibrium Process and Cycle. Fundamental Units, Units of Force, Energy, Specific Volume, Pressure etc. Equality of Temperature, The Zeroth Law of Thermodynamics, Temperature Scales.

Module-2 **08 Hours**

Heat and Work: Definition of Thermodynamic Work, Forms of Work. Definition of Heat, Inter Convertibility of Heat/work into Work/heat, Governing Principles, Sign Convention.

First Law of Thermodynamics: First Law for Cyclic Process, First Law for Change of State of a System. Internal Energy, A New Thermodynamic Property. Enthalpy, The Constant Volume and Constant Pressure**.**

Module-3 **08 Hours**

Second Law of Thermodynamics: Definition of Heat Engine and Reservoirs, Kelvin-Planck and Clausius Statements of the Second Law, Reversible and Irreversible Engines and processes, Causes of Irreversibility, Internal and External Irreversibility.

Carnot Cycle: Efficiency of a Carnot Cycle, Thermodynamic Temperature Scale, Ideal Gas Temperature Scale. **Entropy:** Clausius Inequality, Entropy - A Property of a System, Entropy of a Pure Substance, Entropy Change in Reversible Process, Thermodynamic Property Relation, Calculation of Change in Entropy, Principle of Increase of Entropy.

Module-4 **08 Hours**

Analysis of Power Generation Cycles: Air-standard Power Cycles - Concept, Carnot Cycle, Otto Cycle, Diesel Cycle, Dual Cycle, Brayton Cycle. Efficiency and Mean Effective Pressure. Vapor Power Cycle.

Module-5 **08 Hours**

Analysis of Refrigeration Cycles: Air-standard Cycles - Joule Cycle. Introduction to Refrigeration Systems, Vapor compression Refrigeration Cycle, Vapor-absorption Refrigeration Cycle.

Psychometrics and Air-conditioning Systems: Psychometric properties of Air, Psychometric Chart, Analysing Air conditioning Processes; Heating, Cooling, Dehumidification and Humidification.

Course outcome (Course Skill Set)

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

- Explain fundamentals of thermodynamics and evaluate energy interactions across the boundary of thermodynamic systems.
- Evaluate the feasibility of cyclic and non-cyclic processes using second law of thermodynamics
- Apply the knowledge of entropy, reversibility and irreversibility to solve numerical problems and apply 1st law of thermodynamics to closed and open systems and determine quantity of energy transfers and change in properties.
- Apply thermodynamic concepts to analyse the performance of gas and vapour power cycles.
- Explain the principles, applications of refrigeration and air conditioning systems.

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 Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 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 assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment to a maximum 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 Examinations (SEE)

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

- Basic and Applied Thermodynamics, P K Nag, 2nd Ed., Tata McGraw Hill Publications, 2017.
- A textbook of Engineering Thermodynamics, R K Rajput, Fifth edition, Laxmi Publications, 2019.
- Fundamentals of Thermodynamics by Claus Borgnakke and Richard E Sonntag, 8th edition, Wiley India Edition, 2020
- Thermodynamics, An Engineering Approach, by Yunus A Cenegal, Michael A Boles, and Mehmet Kanoglu, 9th Edition, Tata McGraw Hill publications, 2019

Reference Books

- Engineering Thermodynamics, J B Jones and G A Hawkins, John Wiley and sons, 1986.
- An Introduction to Thermodynamics, Y V C Rao, Wiley Eastern, 2003
- Applications of Thermodynamics, Dr V Kadambi and Dr T R Seetharam, Wiley Publications, 2018

Web links and Video Lectures (e-Resources):
• . https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLD8E646BAB3366BC8 • https://www.youtube.com/watch?v=jkdMtmXo664&list=PL3zvA_WajfGAwLuULH-L0AG9fKDgplYne • https://www.youtube.com/watch?v=1lk7XLOxtzs&list=PLkn3QISf55zy2Nlqr5F09oO2qcIwNNfrZ&index=3 • https://www.youtube.com/watch?v=Dy2UeVCSRYs&list=PL2_EyjPqHc10CTN7cHiM5xB2qD7BHUry7
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning • Organise Industrial visits to Thermal power plants and submission of report • Case study report and power point presentation on steam power plant. • List of thermal energy devices at homes, hostels and college premises and applicable laws

Casting, joining and Forming Process		Semester	III
Course Code	BMM302	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	03
Examination nature (SEE)	**Theory**		

Course objectives:

- To study various metal forming processes.
- To provide knowledge of various casting process in manufacturing.
- To provide detailed information about the moulding processes.
- To Provide information on casting of ferrous and non-ferrous alloys and inspection techniques to detect defects.
- To acquaint with the basic knowledge on fundamentals of metal forming processes.

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-01 **08 Hours**

Introduction & basic materials used in foundry: Introduction: Definition, Classification of manufacturing processes. Metals cast in the foundry-classification, factors that determine the selection of a casting alloy. Introduction to casting process & steps involved. Introduction to casting process & steps involved. Patterns: Definition, classification, materials used for pattern, various pattern allowances and their importance.

Sand moulding: Types of base sand, requirement of base sand. Binder, Additive's definition, need and types; preparation of sand moulds. Molding machines- Jolt type, squeeze type and Sand slinger.

Study of important moulding process: Green sand, core sand, dry sand, sweep mould, CO2mould, shell mould, investment mould, plaster mould, cement bonded mould.

Cores: Definition, need, types. Method of making cores, Concept of gating (top, bottom, parting line, horn gate) and risers (open, blind) Functions and types.

MODULE-02 **08 Hours**

Melting furnaces: Classification of furnaces, Gas fired pit furnace, Resistance furnace, Coreless induction furnace, electric arc furnace, constructional features & working principle of cupola furnace.

Casting using metal moulds: Gravity die casting, pressure die casting, centrifugal casting, squeeze casting, slush casting, thixocasting, and continuous casting processes. Casting defects, their causes and remedies.

MODULE-3 **08 Hours**

SOLIDIFICATION & NON-FERROUS FOUNDRY PRACTICE
Solidification: Definition, Nucleation, solidification variables, Directional solidification-need and methods. Degasification in liquid metals-Sources of gas, degasification methods. **Fettling and cleaning of castings:** Basic steps involved. Sand Casting defects- causes, features and remedies. Advantages & limitations of casting process. **Nonferrous foundry practice**: Aluminium castings - Advantages, limitations, melting of aluminium using lift-out type crucible furnace. Hardeners used, dressing, gas absorption, fluxing and flushing, grain refining, pouring temperature. Stir casting set up, procedure, uses, advantages and limitations.
MODULE-4 **08 Hours**
Mechanical Working of Metals: Introduction to metal forming processes & classification of metal forming processes. Hot working & cold working of metals. **Forging:** Classification of forging processes. Forging machines equipment. Expressions for forging pressures & load in open die forging and closed die forging by slab analysis. Smith forging, drop forging & press forging. Forging Equipment, Defects in forging. **Rolling**: Classification of rolling processes. Types of rolling mills, Variables of rolling process, expression for rolling load. Roll separating force, Rolling defects
MODULE-5 **08 Hours**
Drawing & Extrusion: Drawing of wires, rods & pipes, Variables of drawing process. Difference between drawing & extrusion. Types of Extrusion: Direct, reverse, impact, hydrostatic extrusion. Dies for extrusion, stock penetration. Extrusion ratio of force equipment (with and without friction) **Sheet Metal Operations:** Blanking, piercing, punching, drawing, draw ratio, drawing force, variables in Drawing, Trimming, and Shearing. Bending - types of bending dies, Bending force calculation, Embossing and coining. Types of dies: Progressive, compound and combination dies.

PRACTICAL COMPONENT OF IPCC

Course objectives:

- Impart fundamental understanding of various casting, welding and forming processes.
- To provide in-depth knowledge on metallurgical aspects during solidification of metal and alloys
- Discuss design methodology and process parameters involve in obtaining defect free component.

Sl.NO	Experiments
1	Studying the effect of the clay and moisture content on sand mould properties
2	Preparation of sand specimens and conduction of the following tests: 1. Compression, Shear and Tensile tests on Universal Sand Testing Machine.
3	To determine permeability number of green sand, core sand and raw sand.
4	To determine AFS fineness no. and distribution coefficient of given sand sample.
5	Use of foundry tools and other equipment's.
6	Preparation of moulding sand mixture.
7	Preparation of green sand moulds using two moulding boxes kept ready for pouring. • Using patterns (Single piece pattern and Split pattern) • Without patterns. Incorporating core in the mould. (Core boxes). Preparation of a casting (Aluminium or cast iron-Demonstration only)
8	Calculation of length of the raw material required to prepare the model considering scale losses
9	Preparing minimum three forged models involving upsetting, drawing and bending operations. Demonstration of forging model using Power Hammer

Course outcomes (Course Skill Set):

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

1. Select appropriate primary manufacturing process and related parameters for obtaining initial shape and size of components.
2. Design and develop adequate tooling linked with casting, welding and forming operations.
3. Appreciate the effect of process parameters on quality of manufactured components
4. Demonstrate various skills in preparation of molding sand for conducting tensile, shear and compression tests using Universal sand testing machine.
5. Demonstrate skills in preparation of forging models involving upsetting, drawing and bending operations, Welding models.

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**)

- 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 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

1. Ghosh, A. and Mallik, A. K., (2017), Manufacturing Science, East-West Press.
2. Parmar R. S., (2007), Welding Processes and Technology, Khanna Publishers.
3. Little R. L. – 'Welding and Welding Technology' – Tata McGraw Hill Publishing Company Limited, New Delhi – 1989
4. Grong O. – 'Metallurgical Modelling of Welding' – The Institute of Materials – 1997 – 2nd Edition
5. Kou S. – 'Welding Metallurgy' – John Wiley Publications, New York – 2003 – 2nd Edition.
6. Serope Kalpakjian and Steven R. Schmid – 'Manufacturing Engineering and Technology' – Prentice Hall – 2013 – 7th Edition
7. Principles of foundry technology, 4th edition, P L Jain, Tata McGraw Hill, 2006.
8. Advanced Welding Processes technology and process control, John Norrish, Wood Head Publishing, 2006.

Web links and Video Lectures (e-Resources):

- (Link:http://www.springer.com/us/book/9781447151784http://nptel.ac.in/courses/112105127/)
- http://www.astm.org/DIGITAL_LIBRARY/MNL/SOURCE_PAGES/MNL11.htm
- http://www.astm.org/DIGITAL_LIBRARY/JOURNALS/COMPTECH/PAGES/CTR10654J.htm
- MOOCs: http://nptel.ac.in/courses/112105126/.

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

- Metal Casting: Design pattern/core for a given component drawing and develop a sand mould with optimum gating and riser system for ferrous and non-ferrous materials. Melting and casting, inspection for macroscopic casting defects.
- Metal Forming: Press working operation – hydraulic and mechanical press -load calculation: blanking, bending and drawing operations – sheet metal layout design.

Material Science and Engineering		Semester	III
Course Code	BMM303	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	03
Examination nature (SEE)	Theory		

Course objectives:

- The foundation for understanding the structure and various modes of failure in materials common in Mechanical & Smart Manufacturing.
- Topics are designed to explore the mechanical properties of metals and their alloys, polymers, ceramics, smart materials and composites.
- The means of modifying such properties, as well as the processing and failure of materials.
- Concepts of use of materials for various applications are highlighted.

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 **08 Hours**

Basics, Mechanical Behaviour, Failure of Materials Introduction to Crystal Structure – Coordination number, atomic packing factor, Simple Cubic, BCC, FCC and HCP Structures, Crystal imperfections – point, line, surface and volume imperfections, Atomic Diffusion: Phenomenon, Fick's laws of diffusion; Factors affecting diffusion.

Mechanical Behaviour: Stress-strain diagrams showing ductile and brittle behaviour of materials, Engineering and true strains, Linear and non-linear elastic behaviour and properties, Mechanical properties in plastic range. Stiffness, Yield strength, Offset Yield strength, Ductility, Ultimate Tensile strength, Toughness, Plastic deformation of single crystal by slip and twinning, Mechanisms of strengthening in metal

MODULE - 2 **08 Hours**

Fracture: Type I, Type II and Type III,
Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, Fatigue properties, S-N diagram, Fatigue testing.
Creep: Description of the phenomenon with examples, three stages of creep, creep properties, Stress relaxation. Concept of fracture toughness.

MODULE - 3 **08 Hours**

Alloys, Steels, Solidification
Concept of formation of alloys: Types of alloys, solid solutions, factors affecting solid solubility (Hume Rothery rules), Binary phase diagrams: Eutectic, and Eutectoid systems, Lever rule, Substitutional and interstitial solid solutions, Intermediate phases, Gibbs phase rule Effect of non- equilibrium cooling, Coring and Homogenization Iron-Carbon (Cementite) diagram: description of phases, Specifications of steels. Solidification: Mechanism of solidification, Homogenous and Heterogeneous nucleation, Crystal growth, Numerical on lever rule

MODULE - 4 **08 Hours**

Mechanical Working of Metals: Introduction to metal forming processes & classification of metal forming processes. Hot working & cold working of metals.
Forging: Classification of forging processes. Forging machines equipment. Expressions for forging pressures & load in open die forging and closed die forging by slab analysis. Smith forging, drop forging & press forging. Forging Equipment, Defects in forging.
Rolling: Classification of rolling processes. Types of rolling mills, Variables of rolling process, expression for rolling oad. Roll separating force, Rolling defects

MODULE - 5 **08 Hours**

Composites: Definition; Classification and characteristics of composite materials, Volume fraction, Laminated composites, particulate composites, fibrous composites. Types of reinforcements, their shape and size, production and properties of fiber reinforced plastics, Metal Matrix composites and ceramic matrix composites and their Applications. Fundamentals of production of composites, Processes for production of composites, Constitutive relations of composites, Numerical problems on determining properties of composites.

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Specimen preparation for macro and micro structural examinations and study the macrostructure and microstructure of a sample metal/ alloys-
2	To study the crystal structure of a given Cast Iron, Mild steel, Aluminium and Copper/Brass specimens and study the crystal imperfections in a given Cast Iron, Mild steel and Aluminium specimens.
3	Study the heat treatment processes (Hardening and tempering) of steel/Aluminium specimens.
4	To determine the hardness values of Mild Steel/ Aluminium by Rockwell hardness/Vickers Hardness.
5	To determine the hardness values of Copper/ Brass by Brinell's Hardness testing machine.
6	To study the creep behaviour of a given Cast Iron or Aluminium specimen.
7	To study of microstructure of welding Mild Steel components and Heat affected zone (HAZ) macro and micro examinations
8	To determine the tensile strength, modulus of elasticity, yield stress, % of elongation and % of reduction in area of Cast Iron, Mild Steel/Brass/ Aluminium and to observe the necking.
9	To conduct a wear test on Mild steel/ Cast Iron/Aluminium/ Copper to find the volumetric wear rate and coefficient of friction.
10	Study the chemical corrosion and its protection. ***Demonstration***

Course outcomes (Course Skill Set):

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

- Describe the mechanical properties of metals, their alloys and various modes of failure.
- Understand the microstructures of ferrous and non-ferrous materials to mechanical properties.
- Explain the processes of heat treatment of various alloys.
- Understand the properties and potentialities of various materials available and material selection procedures.
- Know about composite materials and their processing as well as applications.

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**)

- 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 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

Text Books:

1. Ashby, M.F. (2010), *Materials Selection in Mechanical Design*, 4th Edition, Butterworth- Heinemann.
2. Azaroff, L.V., (2001) *Introduction to solids*, 1st Edition, McGraw Hill Book Company.
3. Smith, *Foundation of Material Science & Engineering*, 4th Edition, McGraw Hill Education.
4. Powder Metallurgy Technology, Cambridge International Science Publishing,2002.

Reference Books

1. Jones, D.R.H., and Ashby,M.F., (2012), *Engineering Materials 2:* An Introduction to Microstructure and Processing, 4th Edition, Butterworth-Heinemann.
2. Callister Jr, W.D., Rethwisch, D.G., (2018), *Materials Science and Engineering: An Introduction*, 10th Edition, Hoboken, NJ: Wiley.

Web links and Video Lectures (e-Resources):

- Bhattacharya,B., *Materials Selection and Design,* NPTEL Course Material, Department of Mechanical & Smart Manufacturing, Indian Institute of Technology Kanpur, http://nptel.ac.in/courses/112104122/
- Prasad, R., Introduction to Materials Science and Engineering, NPTEL Course Material, Department of Materials Science and Engineering, Indian Institute of Technology Delhi,http://nptel.ac.in/courses/113102080/
- Subramaniam, A., Structure of Materials, NPTEL Course Material, Department of Material Science and Engineering, Indian Institute of Technology Kanpur,https://nptel.ac.in/courses/113104014/.

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

- **Course seminar**
- **Industrial tour**

	Mechanics of Materials	Semester	III
Course Code	BMM304	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	03
Examination type (SEE)	Theory		

Course objectives:

- To know the different types of stresses and strains developed in the member subjected to axial, bending, shear, torsion & thermal loads.
- To know behaviour & properties of engineering materials.
- To understand the stresses developed in bars, compounds bars, beams, shafts, and cylinders.
- To understand the concepts of calculation of shear force and bending moment for beams with different supports.
- To expose the students to concepts of Buckling of columns and strain energy.

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 **08 Hours**

Stresses and Strains: Introduction, Properties of materials, Stress, Strain and Hooke's law, Stress strain diagram for brittle and ductile materials, True stress and strain, Calculation of stresses in straight, Stepped and tapered sections, Composite sections, Stresses due to temperature change, Shear stress and strain, Lateral strain and Poisson's ratio, Elastic constants and relations between them.

Module-2 **08 Hours**

Analysis of Stress and Strain: Introduction to three-dimensional state of stress, Stresses on inclined planes, Principal stresses and maximum shear stress, Principal angles, Shear stresses on principal planes, Maximum shear stress, Mohr circle for plane stress conditions.

Cylinders-Thin cylinder: Hoop's stress, maximum shear stress, circumferential and longitudinal strains, Thick cylinders: Lames equations.

Module-3	08 Hours

Shear Force and Bending Moment: Type of beams, Loads and reactions, Relationship between loads, shear forces and bending moments, Shear force and bending moments of cantilever beams, Pin support and roller supported beams subjected to concentrated loads, uniformly distributed constant / varying loads. **Concept of shear center.**

Stress in Beams: Bending and shear stress distribution in rectangular, I and T section beams.

Module-4	08 Hours

Theories of Failure: Maximum Principal stress theory, Maximum shear stress theory.

Torsion: Circular solid and hallow shafts, Torsional moment of resistance, Power transmission of straight and stepped shafts, Twist in shaft sections, Thin tubular sections, Thin walled sections.,

Module-5	08 Hours

Columns: Buckling and stability, Critical load, Columns with pinned ends, Columns with other support conditions, Effective length of columns, Secant formula for columns.

Strain Energy: Strain energy due to axial, shear, bending, torsion and impact load. Castigliano's theorem I and II and their applications

Course outcome (Course Skill Set)

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

1. Understand simple, compound, thermal stresses and strains their relations and strain energy.
2. Analyse structural members for stresses, strains and deformations.
3. Analyse the structural members subjected to bending and shear loads.
4. Analyse shafts subjected to twisting loads.
5. Analyze the short columns for stability

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 Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 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 assignment 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.

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 Examinations (SEE) for PCC:

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 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

1. Mechanics of Materials J M Gere, B J Goodno, Cengage Eighth edition 2013
2. Fundamentals of Strength of Materials P N Chandramouli PHI Learning Pvt. Ltd 2013
3. Strength of Materials R K Rajput S. Chand and Company Pvt. Ltd 2014
4. Strength of Materials R. Subramanian Oxford 2005
5. Strength of Materials S. S. Ratan Tata McGraw Hill 2nd Edition, 2008
6. Mechanics of materials and Strength of Materials S C Pilli and N Balasubramanya Cengage 2019
7. Mechanics of Materials R C Hibbeler Pearson Latest edition

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=Y8tXHk3irqE
- https://www.youtube.com/watch?v=B9lyGZzb_6M
- https://www.youtube.com/watch?v=EEiRLGRsm7g
- https://www.youtube.com/watch?v=LaKIXfYg8Q4

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

- Course seminar
- Term project

ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ
("ವಿ ಟಿ ಯು ಅಧಿನಿಯಮ ೧೯೯೪" ರ ಅಡಿಯಲ್ಲಿ ಕರ್ನಾಟಕ ಸರ್ಕಾರದಿಂದ ಸ್ಥಾಪಿತವಾದ ರಾಜ್ಯ ವಿಶ್ವವಿದ್ಯಾಲಯ)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY

(State University of Government of Karnataka Established as per the VTU Act, 1994)"Jnana Sangama" Belagavi-590018, Karnataka, India)

Prof. B. E. Rangaswamy, Ph.D.
REGISTRAR

Phone: (0831) 2498100
Fax: (0831) 2405467

REF: VTU/BGM/BOS/New UG-PG Prog/2023-24/4618 DATE: 5 DEC 2023

CIRCULAR

Subject: The syllabus of BMEL305-Introduction to Modelling and Design for Manufacturing is revised...

Reference: The email from Chairperson BoS Mechanical Engineering, VTU Belagavi dated 27.11.2023

The Hon'ble Vice Chancellors' approval dated 04.12.2023

The faculty development program has been conducted on the course/subject BMEL305: Introduction to Modelling and Design for Manufacturing between the 6th and 8th of November 2023 at 6 different places in Karnataka to cover the faculty of all zones of VTU Belagavi (ref. VTU/BGM/BOS/FDP/2023-24/3728, Dated October 31, 2023).

Based on the feedback received from the faculty, the syllabus of the course/subject **BMEL305: Introduction to Modelling and Design for Manufacturing** has been revised and submitted to the university for circulation to all concerned by the Board of Studies in Mechanical Engineering, VTU Belagavi.

A revised syllabus copy has been enclosed in this circular for stakeholder reference. The revised syllabus of the course will take effect in the academic year 2023-24 for Mechanical Engineering and its allied branches.

All the principals of the engineering colleges are hereby informed to bring the content of the circular to the notice of all concerned.

Sd/-
Registrar

To,
All the Principals of Affiliated /Constituent Engineering Colleges, under the University.
The Chairperson / Program Coordinator, University Department at Kalaburagai, Belagavi, Bengaluru and Mysuru

Copy to:

1. The Hon'ble Vice-Chancellor through the secretary to VC VTU Belagavi for information
2. The Registrar (Evaluation) VTU Belagavi for information and needful

3. The Director, ITI SMU, VTU Belagavi for information and request to make arrangements for uploading this circular on the VTU web portal in the section of Circular/Notification @ https:// vtu.ac.in/ en/ category/ administration/
4. The Chairperson/s Board of Studies in Mechanical Engineering and its allied branches
5. The Special Officer, QPDS Examination Section VTU Belagavi for needful.
6. Office Copy

05/12/23

REGISTRAR

05/12/23

Introduction to Modelling and Design for Manufacturing		Semester	3
Course Code	**BMEL305**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**0:0:2:0**	SEE Marks	50
Total Hours of Pedagogy	**14 Sessions**	Total Marks	100
Credits	**01**	Exam Hours	3
Examination nature (SEE)	**Practical**		

Course objectives:

- Develop a comprehensive understanding of mechanical assemblies and design for manufacturing principles.
- Learn and apply best practices to create designs that are robust, adaptable, and cost-effective.
- Master the art of maintaining control over designs throughout the entire lifecycle, from initial sketch to final production.
- Gain hands-on experience in practical exercises and projects to reinforce theoretical concepts.
- Acquire effective communication and collaboration skills for multidisciplinary teamwork in design and production processes.

Teaching-Learning Process (General Instructions)

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

- Project-Based Learning: Engage students in hands-on projects that simulate real-world design scenarios, enabling practical application of concepts and fostering deeper understanding.
- Interactive Workshops: Conduct collaborative workshops where students work together to solve design challenges, encouraging active participation and knowledge sharing.
- Design Reviews with Feedback: Regularly review student designs, providing constructive feedback to guide iterative improvement and promote attention to detail.
- Industry Insights: Invite guest speakers from the industry to share experiences and insights, helping students connect theoretical knowledge to real-world applications.
- Multidisciplinary Teams: Form diverse teams for group projects, allowing students to leverage different skill sets and perspectives to develop comprehensive designs.

Module-1 — 02 Sessions

Introduction to Computer Aided Sketching Review of graphic interface of the software. Review of 2D Sketching, Parametric Solid Modelling, Assembly creation and product rendering. Limits, Fits and Tolerances: Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, Types of fits with symbols and applications, Geometrical tolerances on drawings, Standards followed in industry. (**Above topics to be studied as a review)**

Geometrical Dimensioning and Tolerances (GD&T): Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, machining symbols, types of fits with symbols and applications, geometrical tolerances on drawings. Standards followed in industry. **(Only for CIE)**

The basics of sketching and modelling: Explore Fusion 360 User Interface, Navigation and display settings, create new projects and designs, creating basic 2D sketches, Creating & Modifying a solid 3D body with Sections. **(For SEE)**

Module-2 — 02 Sessions

Create draft during a feature, create draft as a feature, Add ribs and plastic supports, Create holes and threads. Thread Forms: Terminologies, ISO Metric, BSW, Square & Acme. Seller threads, American Standard Thread. Use a coil feature, Mirrors and patterns. Fasteners: 3D & Section views - Hexagonal headed bolt and nut with washer, Square headed bolt and nut with washer. **Keys**: Parallel Key, Taper Key & Feather Key.

Module-3 — 04 Sessions

The different ways to create components, Use scripts to create gears, Component color swatch and color cycling, Use McMaster-Carr parts in a design. Assembly of Joints and Coupling using 3D environment.

Joints: Like Cotter joint (socket and spigot), knuckle joint (pin joint). **Couplings:** Like flanged coupling, universal coupling.

27-11-2023.

Module-4	06 Sessions

Assembly Drawings: (Part drawings shall be given) Drawing Basics-Detailing Drawings. Explode a 3D model for a drawing, Create a drawing sheet and views, Add geometry and dimensions to a drawing, Add GD & T text, BOM, tables and symbols, Place an exploded view, Edit a title block, Export to different file formats.

1. **LIFTING DEVICE (Screw Jack)**
2. **BEARINGS (Plumber Block)**
3. **MACHINE TOOL COMPONENT (Machine Vice or Tailstock)**
4. **VALVES (Ram's Bottom Safety Valve)**
5. **IC ENGINE COMPONENTS (Piston or Connecting Rod)**

Course outcome (Course Skill Set)

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

1. Create and modify a form-based design.
2. Use design tools for moulded parts.
3. Demonstrate proficiency in the setup and creation of a design.
4. Simulate the assembly of machine components in 3D environment.

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 (CIE):

- CIE marks for the practical course is 50 Marks.
- CIE shall be evaluated for max marks 100. Marks obtained shall be accounted for CIE final marks, reducing it by 50%.
- CIE component should comprise of
  - Continuous evaluation of Drawing work of students as and when the Modules are covered.
  - At least one closed book Test covering all the modules on the basis of below detailed weightage.
  - *Weightage for Test and Continuous evaluation shall be suitably decided by respective course coordinators.*

Module	Max. Marks weightage	Evaluation Weightage in marks	
		Computer display & printout	Preparatory sketching
Module-1	15	10	05
Module-2	15	10	05
Module-3	30	20	10
Module-4	40	30	10
Total	**100**	**70**	**30**

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

- The duration of SEE is 03 hours. Questions shall be set worth of 3 hours
- SEE shall be conducted jointly by the two examiners (one internal and one external) appointed by the University.
- SEE shall be conducted and evaluated for maximum of 100 marks as shown in the table below. Marks obtained shall be accounted for SEE final marks, reducing it to 50 marks.
- Question paper shall be set jointly by both examiners and made available for each batch as per schedule.
- Evaluation shall be carried jointly by both the examiners.
- Scheme of Evaluation: To be defined by the examiners jointly and the same shall be submitted to the university along with question paper.

- One full question shall be set from each Modules as per the below tabled weightage details. ***However, the student may be awarded full marks, if he/she completes solution on computer display without sketch***

Module	Max. Marks weightage	Evaluation Weightage in marks	
		Computer display & printout	Preparatory sketching
Module-1 **or** Module-2	20	15	05
Module-3	30	20	10
Module-4	50	40	10
Total	**100**	**75**	**25**

Suggested Learning Resources:

Books

Text Books:

1. K L Narayana, P Kannaiah, K Venkata Reddy, "Machine Drawing", New Age International, 3rd Edition. ISBN-13: 978-81-224-2518-5, 2006
2. N D Bhatt , "Machine Drawing", Charotar Publishing House Pvt. Ltd.,50th Edition, ISBN-13: 978-9385039232, 2014
3. Machine drawing by K R Gopalakrishna, Subhash Publication

Web links and Video Lectures (e-Resources):

- Learn Fusion 360 in 90 Minutes
  https://www.autodesk.com/certification/learn/course/learn-fusion-360-in-90-minutes

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

Complex Analysis, Probability and statistics Methods & Linear Programming		Semester	III
Course Code	BMM306A	CIE	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE	50
Total Hours of Pedagogy	40	Total	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Course objectives:

- To provide an insight into applications of complex variables and conformal mapping arising in potential theory, quantum mechanics, heat conduction and field theory.
- To develop probability distribution of discrete, continuous random variables and joint probability distribution occurring in digital signal processing, design engineering and microwave engineering.
- Analyze and solve linear programming models of real-life situations and learn about the applications to transportation and assignment problems.

Teaching-Learning Process (General Instructions)

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

- In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
- State the need for Mathematics with Engineering Studies and Provide real-life examples.
- Support and guide the students for self–study.
- You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
- Encourage the students for group learning to improve their creative and analytical skills.

Show short related video lectures in the following ways

- As an introduction to new topics (pre-lecture activity).
- As a revision of topics (post-lecture activity).
- As additional examples (post-lecture activity).
- As an additional material of challenging topics (pre-and post-lecture activity).
- As a model solution for some exercises (post-lecture activity).

Module-1	08 Hours

Calculus of complex functions: Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms and consequences. Applications to flow problems. Construction of analytic functions: Milne-Thomson method-Problems.

Self-Study: Review of a function of a complex variable, limits, continuity, and differentiability.

Module-2	08 Hours

Conformal transformations: Introduction. Discussion of transformations $w = z^2$, $w = e^z$, $w = z + \frac{1}{z}, (z \neq 0)$. Bilinear transformations- Problems.

Complex integration: Line integral of a complex function-Cauchy's theorem and Cauchy's integral formula and problems

Self-Study: Residues, Residue theorem – problems

Module-3	08 Hours

Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Mean-Variance and Standard Deviations of a random variable. Binomial, Poisson, exponential and normal distributions- problems.

Self-Study: Two-dimensional random variables, marginals pdf's, Independent random variables

Module-4	08 Hours

Linear Programming Problems (L.P.P): General Linear programming Problem, Canonical and standard forms of L.P.P. Basic solution, Basic feasible solution, Optimal solution, Simplex Method-Problems. Artificial variables, Big-M method, Two-Phase method-Problems.

Self-Study: Formulation of an L.P.P and optimal solution by Graphical Method.

Module-5	08 Hours

Transportation and Assignment Problems: Formulation of transportation problems, Methods of finding initial basic feasible solutions by North-West corner method, Least cost method, Vogel approximation method. Optimal solutions-Problems. Formulation of assignment problems, Hungarian method-Problems.
Self-Study: Degeneracy in Transportation problem.

Course outcome (Course Skill Set)

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

- Use the concepts of an analytic function and complex potentials to solve the problems arising in fluid flow.
- Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.
- Apply discrete and continuous probability distributions in analyzing the probability models arising in the engineering field.
- Analyze and solve linear programming models of real-life situations and solve LPP by the simplex method
- Learn techniques to solve Transportation and Assignment problems.

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 Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 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 assignment 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.

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 Examinations (SEE)

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:

Text Books:

- B. S. Grewal: "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018
- E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons,10th Ed. (Reprint),2016.
- S.D. Sharma: "Operations Research" Kedarnath Publishers Ed. 2012

Reference Books

- V. Ramana: "*Higher Engineering Mathematics*" McGraw-Hill Education,11th Ed.
- Mokhtar S.Bazaraa, John J.Jarvis & Hanif D.Sherali(2010*), Linear Programming and Network Flows(* 4th E*dition), John Wiley & sons.*
- G.Hadley (2002) *Linear Programming, Narosa Publishing House*
- F.S. Hillier. G.J. Lieberman: Introduction to Operations Research- Concepts and Cases, 9th Edition, Tata Mc-Graw Hill, 2010.
- Srimanta Pal & Subodh C. Bhunia: "Engineering Mathematics" Oxford University Press,3rdReprint, 2016.
- N.P Bali and Manish Goyal: "A textbook of Engineering Mathematics" Laxmi Publications, Latest edition.
- C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics" McGraw – Hill Book Co. New York, Latest ed.
- H.K. Dass and Er. RajnishVerma:"Higher EngineeringMathematics"S.ChandPublication(2014).

Web links and Video Lectures (e-Resources):

- http://.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- https://www.coursera.org/learn/operations-research-modeling
- https://www.careers360.com/university/indian-institute-of-technology-madras/introduction-operations-research-certification-course
- http://people.whitman.edu/~hundledr/courses/M339.html

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

- Quizzes
- Assignments
- Seminars

	Non Traditional Machining	Semester	III
Course Code	BMM306B	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	03
Examination type (SEE)	Theory		

Course objectives:

- To learn various concepts related to modern machining processes & their applications.
- To appreciate the differences between conventional and non-conventional machining processes.
- To acquire a functional understanding of non-traditional manufacturing equipment.
- To know about various process parameters and their influence on performance and their applications.
- To impart knowledge on various types of energy involved in non-traditional machining processes.

Teaching-Learning Process (General Instructions)

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

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

Module-1	08 Hours
Introduction to Non-traditional machining, Need for Non-traditional machining process, Comparison between traditional and non-traditional machining, general classification Non-traditional machining processes, classification based on nature of energy employed in machining, selection of non-traditional machining processes, Specific advantages, limitations and applications of non-traditional machining processes.	
Module-2	**08 Hours**
Ultrasonic Machining (USM): Introduction, Equipment and material process, Effect of process parameters: Effect of amplitude and frequency, Effect of abrasive grain diameter, effect of slurry, tool & work material. Process characteristics: Material removal rate, tool wear, accuracy, surface finish, applications, advantages & limitations of USM. Abrasive Jet Machining (AJM): Introduction, Equipment and process of material removal, process variables: carrier gas, type of abrasive, work material, stand-off distance (SOD).	
Module-3	**08 Hours**
ELECTROCHEMICAL MACHINING (ECM): Introduction, Principle of electro chemical machining, ECM equipment, elements of ECM operation, Chemistry of ECM. ECM Process characteristics: Material removal rate, accuracy, surface finish. Process parameters: Current density, Tool feed rate, Gap between tool & work piece, velocity of electrolyte flow, type of electrolyte, its concentration temperature, and choice of electrolytes.	
Module-4	**08 Hours**
ELECTRICAL DISCHARGE MACHINING (EDM): Introduction, mechanism of metal removal, EDM equipment: spark erosion generator (relaxation type), dielectric medium-its functions & desirable properties, electrode feed control system. Flushing types; pressure flushing, suction flushing, side flushing, pulsed flushing. EDM **process parameters:** Spark frequency, current & spark gap, surface finish, Heat Affected Zone. Advantages, limitations & applications of EDM, Electrical discharge grinding, Traveling wire EDM. PLASMA ARC MACHINING (PAM): Introduction, non-thermal generation of plasma, equipment mechanism of metal removal, Plasma torch, process parameters, process characteristics. Safety precautions. Safety precautions, applications, advantages and limitations.	
Module-5	**08 Hours**
LASER BEAM MACHINING (LBM): Introduction, generation of LASER, Equipment and mechanism of metal removal, LBM parameters and characteristics, Applications, Advantages & limitations. ELECTRON BEAM MACHINING (EBM): Introduction, Principle, equipment and mechanism of metal removal, applications, advantages and limitations.	
Course outcome (Course Skill Set)	
At the end of the course the student will be able to: • Understand the compare traditional and non-traditional machining process and recognize the need for Non-traditional machining process. • Understand the constructional features, performance parameters, process characteristics, applications, advantages and limitations of USM, AJM and WJM. • Identify the need of Chemical and electro-chemical machining process along with the constructional features, process parameters, process characteristics, applications, advantages and limitations. • Understand the constructional feature of the equipment, process parameters, process characteristics, applications, advantages and limitations EDM & PAM. • Understand the LBM equipment, LBM parameters, and characteristics. EBM equipment and mechanism metal removal, applications, advantages and limitations LBM & EBM	

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 Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 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
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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.

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 Examinations (SEE)

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:

Text Books:

1. Modern Machining Process P.C Pandey and H S Shah McGraw Hill Education India Pvt. Ltd. 2000
2. Production technology HMT McGraw Hill Education India Pvt. Ltd 2001
3. New Technology Dr. Amitabha Bhattacharyya The Institute of Engineers (India) 2000

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=VwcUiBLuHw&pp=ygUZbm9uIHRyYWRpdGlvbmFsIG1hY2hpbmluZw%3D%3D
- https://www.youtube.com/watch?v=PaYInS9axxw&list=PLzCSUZGIUJkaSyCzPiQMWynGyxmC8hrpl
- https://www.youtube.com/watch?v=j7j17jQFmHk&pp=ygUZbm9uIHRyYWRpdGlvbmFsIG1hY2hpbmluZw%3D%3D

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

- Quizzes
- Assignments
- Seminars

	Introduction to Python	Semester	III
Course Code	BMM306C	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	03
Examination type (SEE)	Theory		

Course objectives:

- Learn the syntax and semantics of the Python programming language.
- Illustrate the process of structuring the data using lists, tuples
- Appraise the need for working with various documents like Excel, PDF, Word and Others.
- Demonstrate the use of built-in functions to navigate the file system.
- Implement the Object Oriented Programming concepts in Python.

Teaching-Learning Process (General Instructions)

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

1. Use https://pythontutor.com/visualize.html#mode=edit in order to visualize the python code
2. Demonstrate and visualize basic data types (list, tuple, dictionary).
3. Chalk and talk
4. online and videos

Module-1	08 Hours

Python Basics: Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program, Flow control: Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules, Ending a Program Early with sys.exit(), Functions: def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling, A Short Program: Guess the Number Textbook 1: Chapters 1 – 3.

Module-2	08 Hours

Lists: The List Data Type, Working with Lists, Augmented Assignment Operators, Methods, Example Program: Magic 8 Ball with a List, List-like Types: Strings and Tuples, References, Dictionaries and Structuring Data: The Dictionary Data Type, Pretty Printing, Using Data Structures to Model Real-World Things, Textbook 1: Chapters 4 – 5

Module-3	08 Hours

Manipulating Strings: Working with Strings, Useful String Methods, Project: Password Locker, Project: Adding Bullets to Wiki Markup Reading and Writing Files: Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module,Saving Variables with the print.format() Function, Project: Generating Random Quiz Files, Project: Multiclipboard, Textbook 1: Chapters 6 , 8

Module-4	08 Hours

Organizing Files: The shutil Module, Walking a Directory Tree, Compressing Files with the zipfile Module, Project: Renaming Files with American-Style Dates to European-Style Dates,Project: Backing Up a Folder into a ZIP File, Debugging: Raising Exceptions, Getting the Traceback as a String, Assertions, Logging, IDLE‟s Debugger. Textbook 1: Chapters 9-10

Module-5	08 Hours

Classes and objects: Programmer-defined types, Attributes, Rectangles, Instances as return values, Objects are mutable, Copying, Classes and functions: Time, Pure functions, Modifiers, Prototyping versus planning, Classes and methods: Object-oriented features, Printing objects, Another example, A more complicated example,Theinit method, The __str__ method, Operator overloading, Type-based dispatch, Polymorphism, Interface and implementation, Textbook 2: Chapters 15 – 17

Course outcome (Course Skill Set)

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

- Demonstrate proficiency in handling loops and creation of functions.
- Identify the methods to create and manipulate lists, tuples and dictionaries.
- Develop programs for string processing and file organization
- Interpret the concepts of Object-Oriented Programming as used in Python.

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 Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 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 assignment 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.

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 Examinations (SEE)

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:

Text Books:

1. Sweigart,"Automate the Boring Stuff with Python",1 stEdition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/) (Chapters 1 to 18, except 12) for lambda functions use this link: https://www.learnbyexample.org/python-lambda-function/
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2 nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at http://greenteapress.com/thinkpython2/thinkpython2.pdf (Chapters 13, 15, 16, 17, 18) (Download pdf/html files from the above link)

Web links and Video Lectures (e-Resources):

- https://www.learnbyexample.org/python/
- https://www.learnpython.org/
- https://pythontutor.com/visualize.html#mode=edit

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

- Quizzes for list, tuple, string dictionary slicing operations using below link https://github.com/sushantkhara/Data-Structures-And-Algorithms-withPython/raw/main/Python%203%20_%20400%20exercises%20and%20solutions%20for%20beginners.pdf

Ability Enhancement Course/Skill Enhancement Course - III

INTRODUCTION TO VIRTUAL REALITY

Course Code	**BMM358A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**0:2:0:0**	SEE Marks	50
Total Hours of Pedagogy	**30**	Total Marks	100
Credits	**01**	Exam Hours	01

Course objectives:

- Describe how VR systems work and list the applications of VR.
- Understand the design and implementation of the hardware that enables VR systems to be built.
- Understand the system of human vision and its implication on perception and rendering.
- Explain the concepts of motion and tracking in VR systems.
- Describe the importance of interaction and audio in VR systems.

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

Introduction to Virtual Reality : Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output- Visual, Aural & Haptic Displays, Applications of Virtual Reality.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-2

Representing the Virtual World : Representation of the Virtual World, Visual Representation in VR, Aural Representation in VR and Haptic Representation in VR

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-3

The Geometry of Virtual Worlds &The Physiology of Human Vision: Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-4	
Visual Perception & Rendering : Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Combining Sources of Information Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Module-5	
Motion & Tracking : Motion in Real and Virtual Worlds- Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection Tracking- Tracking 2D & 3D Orientation, Tracking Position and Orientation, Tracking Attached Bodies	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Course outcome (Course Skill Set)

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

CO1: Describe how VR systems work and list the applications of VR.

CO2: Understand the design and implementation of the hardware that enables VR systems to be built.

CO3: Understand the system of human vision and its implication on perception and rendering.

CO4: Explain the concepts of motion and tracking in VR systems.

CO5: Describe the importance of interaction and audio in VR systems.

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). 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 35% (18 Marks out of 50)in the semester-end examination(SEE), and 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 Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 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 assignment 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.

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 Examinations (SEE)

- SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.**
- The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.

Reference Books:

1. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
3. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.
4. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.

Web links and Video Lectures (e-Resources):

http://lavalle.pl/vr/book.html
https://nptel.ac.in/courses/106/106/106106138/
https://www.coursera.org/learn/introduction-virtual-reality.

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

- Course seminars

DATA BASE MANAGEMENT SYSTEMS		Sem	III
Course Code	**BMM358B**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**0:2:0:0**	SEE Marks	50
Total Hours of Pedagogy	**30**	Total Marks	100
Credits	**01**	Exam Hours	01

Course objectives:

- Understand DBMS concept
- Understand the Data base languages and architecture
- Explain Relational models and application development
- Explain the concepts of Data design theory

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

Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications.

Overview of Database Languages and Architectures:

Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-2

Relational Model:
Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations.

Relational Algebra:
Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra.

Mapping Conceptual Design into a Logical Design:
Relational Database Design using ER-to-Relational mapping.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-3

SQL : Advances Queries:
More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL.

Database Application Development:
Accessing databases from applications, An introduction to JDBC, JDBC classes and interfaces, SQLJ, Stored procedures, Case study: The internet Bookshop.

Internet Applications:
The three-Tier application architecture, The presentation layer, The Middle Tier

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-4

Normalization: Database Design Theory –
Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form.

Normalization Algorithms:
Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decompositions, Algorithms for Relational Database Schema Design, Nulls, Dangling tuples, and alternate Relational Designs, Further discussion of Multivalued dependencies and 4NF, Other dependencies and Normal Forms

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-5

Transaction Processing:
Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL.

Concurrency Control in Databases:
Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering, Multiversion Concurrency control techniques, Validation Concurrency control techniques, Granularity of Data items and Multiple Granularity Locking

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Course outcome (Course Skill Set)

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

- Identify, analyze and define database objects, enforce integrity constraints on a database using RDBMS.
- Use Structured Query Language (SQL) for database manipulation.
- Design and build simple database systems
- Develop application to interact with database

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). 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 35% (18 Marks out of 50)in the semester-end examination(SEE), and 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 Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 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 assignment 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.

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 Examinations (SEE)

- SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.**
- The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

Reference Books:

1. Silberschatz Korth and Sudharshan, Database System Concepts, 6th Edition, Mc-GrawHill, 2013.
2. Coronel, Morris, and Rob, Database Principles Fundamentals of Design, Implementation and Management, Cengage Learning 2012.

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=kBdlM6hNDAE&list=PLxCzCOWd7aiFAN6I8CuViBuCdJgiOkT2Y
https://www.youtube.com/watch?v=6Iu45VZGQDk&list=PLBlnK6fEyqRi_CUQ-FXxgzKQ1dwr_ZJWZ
https://www.youtube.com/watch?v=6Iu45VZGQDk&pp=ygUaZGF0YWJhc2UgbWFuYWdlbWVudCBzeXN0ZW0%3D

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

- Course seminars
- Quizzes

INTRODUCTION TO BLOCK CHAIN			
Course Code	**BMM358C**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**0:2:0:0**	SEE Marks	50
Total Hours of Pedagogy	**30**	Total Marks	100
Credits	**01**	Exam Hours	01

Course objectives:

- Define and Explain the fundamentals of Blockchain.
- Illustrate the technologies of block chain.
- Describe the models of block chain.
- Analyze and demonstrate the Ethereum.

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

Block chain 101: Distributed systems, History of block chain, Introduction to block chain, Types of block chain, CAP theorem and block chain, Benefits and limitations of block chain.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-2

Decentralization and Cryptography:

Decentralization using block chain, Methods of decentralization, Routes to decentralization, Decentralized organizations.

Cryptography and Technical Foundations: Cryptographic primitives, Asymmetriccryptography, Public and private keys.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-3

Bitcoin and Alternative Coins A: Bitcoin, Transactions, Block chain, Bitcoin paymentsB: Alternative Coins Theoretical foundations, Bitcoin limitations, Namecoin, Litecoin, Primecoin, Zcash

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-4

Smart Contracts and Ethereum 101:

Smart Contracts: Definition, Ricardian contracts.

Ethereum 101: Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-5

Alternative Blockchains: Blockchains Blockchain-Outside of Currencies: Internet of Things, Government, Health, Finance.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Course outcome (Course Skill Set)

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

- Define and Explain the fundamentals of Blockchain
- Illustrate the technologies of blockchain
- Describe the models of blockchain
- Analyze and demonstrate the Ethereum
- Analyze and demonstrate Hyperledger fabric

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). 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 35% (18 Marks out of 50)in the semester-end examination(SEE), and 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 Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 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 assignment 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.

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 Examinations (SEE)

- SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.**
- The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

1. Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1-78712-544-5,2017
2. Blockchain Technology (Concepts and applications), Kumar saurabh, Ashutosh saxena,Wiley, 2020
3. Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, EdwardFelten,2016.
4. Blockchain Basics: A Non-Technical Introduction in 25 Steps, Daniel Drescher, Apress,First Edition, 2017
5. 5. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media, First Edition, 2014

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=mfSr-c9sAjI&list=PLYwpaL_SFmcDFRupamGc-9zc-vQqvkQnn
https://onlinecourses.nptel.ac.in/noc22_cs44/preview
https://archive.nptel.ac.in/courses/106/105/106105235/
https://onlinecourses.nptel.ac.in/noc20_cs01/preview

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

- Quiz
- Topic Seminar presentation
- Assignment

Sensors, Measurement and Metrology		Semester	IV
Course Code	**BMM401**	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	03
Examination type (SEE)	**Theory**		

Course objectives:

- Able to describe the Sensors and transducers
- Able to explain the basics and methods of indirect measurements.
- Able to explain system of limits, fits, tolerances, gauges and comparators.
- Able to describe metrology, methods, standards, of measurement and measuring instruments
- Able to describe the different Display and Recording Devices

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 **08 Hours**

Introduction to Sensors

Phototube, scintillation counter, Photo Multiplier Tube (PMT), photovoltaic, Photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers, spectrophotometric applications of photo electric transducers. Piezoelectric active transducer and biomedical applications as pressure and Ultrasound transducer.

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

Module-2 **08 Hours**

Measurement system and basic concepts of measurement methods: Definition, Significance of measurement, Generalized measurement system, Static characteristics- Accuracy, Precision, Calibration, Threshold, Sensitivity, Hysteresis, Repeatability, Linearity, Loading effect, Dynamic characteristics- System response, Time delay. Errors in measurement, Classification of errors.

Transducers: Transfer efficiency, Primary and Secondary transducers, Electrical transducers, Mechanical, Electronic transducers, Relative comparison of each type of transducers.

Intermediate Modifying and Terminating Devices: Mechanical systems, Inherent problems, Electrical intermediate modifying devices, Input circuitry, Ballast circuit, Electronic amplifiers. Terminating devices, Cathode ray oscilloscope, Oscillographs.

Module-3 **08 Hours**

System of Limits, Fits, Tolerance and Gauging: Definitions, Tolerance, Tolerance analysis (addition & subtraction of tolerances) Inter changeability & Selective assembly. Class &grade of tolerance, Fits, Types of fits, Numerical on limits, fit and tolerance. Hole base system & shaft base system. Taylor's principle, Types of limit gauges, Numerical on limit gauge design.

Comparators: Functional requirements, Classification, Mechanical- Johnson Mikrokator, Sigma comparators, Dial indicator, Electrical comparators, LVDT, Pneumatic comparators- Principle of back pressure, Solex comparators, Optical comparators- Zeiss ultraoptimeter.

Module-4 **08 Hours**

Introduction to Metrology: Definition, objectives of metrology, Material Standards, Wavelength Standards, Classification of standards, Line and End standards, Calibration of End bars. Numerical examples.

Liner measurement and angular measurements: Slip gauges-Indian standards on slip gauges, Adjustable slip gauges, Wringing of slip gauges, Problems on building of slip gauges (M87, M112), Measurement of angle-sine bar, Sine centre, Angle gauges, Optical instruments for angular measurements. Autocollimator-Applications for measuring straightness and squareness.

Module-5	08 Hours

Display and Recording Devices: Digital voltmeter – Multi meter – CRO – block diagram, CRT – vertical and horizontal deflection system, DSO, LCD monitor, PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder. Demonstration of the display and recording devices.

Course outcome (Course Skill Set)

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

- Able to Understand the working of various instruments and equipments used for the measurement of various electrical engineering parameters like voltage, current, power, phase etc in industry as well as in power generation, transmission and distribution sectors.
- Able to analyze and solve the varieties of problems and issues coming up in the vast field of electrical measurements..
- Analyse the different operation of extension range ammeters and voltmeters, DC and AC bridge for measurement of parameters and different characteristics of periodic and aperiodic signals using CRO
- Design and development of various voltage and current measuring meters and the varieties of issues coming up in the field of electrical measurements

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.

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

- A.K.Sawhney "Electrical & Electronic Measurement & Instruments" Dhanpat Rai & Co. Publications, 2007. 2. E.W. Golding and F.C. Widdis, "Electrical Measurements and measuring Instruments",5th Edition, Reem Publications, 2011.
- H. S. Kalsi, "Electronic Instrumentation", 3rd Edition, Tata Mcgrawhill, 2011
- Reissland, "Electrical Measurements: Fundamentals, Concepts, Applications" –M.U, New Age International (P) Limited, 2010.

- R. K. Rajput, "Electrical & Electronic Measurement & Instrumentation", 2nd Edition, S. Chand & Co., 2nd Edition, 2013.
- Beckwith Marangoni and Lienhard, Mechanical Measurements, 6th Edition, Pearson Education, India, 2006.
- R.K. Jain, Engineering Metrology, 20th Edition, Khanna *Publishers*, New Delhi 2009
- Albert D.Helfrick and William D.Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2007

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/112/104/112104250/
- https://nptel.ac.in/courses/112104250
- https://nptel.ac.in/courses/112107242

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

- Course Seminar

Machining Jigs and Fixtures		Semester	IV
Course Code	**BMM402**	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	03
Examination nature (SEE)	**Theory**		

Course objectives:

- To know the various subtractive machining processes in industries.
- To calculate the values of various forces involved in the machining operations.
- To understand and determine tool wear and tool life of different machining processes.
- To know various non-conventional machining and hybrid machining processes.
- To know the design of jigs and fixtures for various industrial/ machining members.

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-01 **08 Hours**

Introduction to Machining Processes and Machine Tools: Subtractive manufacturing processes and classifications.
Construction, specification operations of machine tools:– Lathe, Shaping, Milling, Drilling, Grinding Machine.
Introduction to CNC machines: CNC Lathe, Milling, Drilling, Machine Centre.

MODULE-02 **08 Hours**

Mechanics of Metal Cutting:
Single point turning tool geometry (SPTT) influences the chip formation mechanisms of the Orthogonal and Oblique cutting process.
Cutting Force Analysis (Orthogonal Cutting): Analysis of machining forces and power requirement, 'Merchant's model of Orthogonal Cutting and Theory of Lee & Shaffer' Chip Velocity, Velocity relationships (simple numerical); the influence of cutting temperature on machinability.
Cutting Fluids: Characteristics of Cutting fluids, Selections, and applying methods of cutting fluids.

MODULE-3 **08 Hours**

Machinability and Tool Life

Process of cutting tool failure wears and time relationship, tool wear index, feed marks, the effect of tool wear on the machined surface, surface finish, machinability, machinability index/rating, tool life & variables affecting tool life, tool materials.

Finishing Process: **Importance of surface finishing processes, Grinding, Abrasive Flow Machining, Honing. Sanding, Abrasive blasting, Polishing, Lapping.**

Surface Finishing and Protection: Powder Coating, Liquid Coating, Electroplating, Galvanizing, Anodizing.

MODULE-4 **08 Hours**

Advanced Machining Process;

Importance and classification of advanced machining process;

Process principal, process parameters, and application of: - Abrasive Jet Machining (AJW), Water Jet Machining (WJM), Abrasive Water Jet Machining (AWJM); Ultrasonic Machining (USM);Electrical Discharge Machining (EDM); Wire Electrical Discharge Machining (WEDM); Electro Chemical Machining (ECM). Laser Beam Machining (LBM), Electron Beam Machining (EBM), and Plasma Arc Machining (PAM).

Hybrid Machining Process: Importance of hybrid machining process;

Process principal, process parameters, and application of: - Electrochemical Discharge Machining (ECDM), Ultrasonic Assisted Electric Discharge Machining (UAEDM), Electrochemical Discharge Grinding (EDG), Powder Assisted Electric Discharge Machining (PAEDM).

MODULE-5 **08 Hours**

Jigs and Fixtures:

Importance of jigs and fixtures; the difference between jigs and fixtures; types of jigs and fixtures; essential features of jigs and fixtures, Materials used.

Factors to be considered for the design of Jigs and Fixtures;

Jigs: Template, Plate, Channel, Diameter, Leaf, Rung, Box,

Fixtures: Turning, Milling, Broaching, Grinding, Boring, Indexing, Tapping, Duplex, Welding, and Assembly fixtures

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	One Job on Lathe machine with simple operations (turning, facing, Thread cutting and tapering) on low carbon steel and/or heat-treated low carbon steel, and Demonstration of tungsten carbide cutting tool inserts.
2	Operations and One Job each on shaping/milling machine
3	Simple operations and One Job on the drilling and grinding machine.
4	Demonstration/Experimentation of simple programming of CNC machine operations.
5	To study the tool geometry of a single point turning tool (SPTT) in the American Standards Association (ASA) system.
6	Cutting force measurement with dynamometers (Demonstration) for turning, drilling, grinding operations.
7	Application of cutting fluids in turning operations and case study on optimizing process parameters onturning operation.
8	Analysis of chip formation and chip reduction coefficient in turning of mild steel by HSS tool with different depth of cut, speed, and feed rate.
9	Experiment on tool wears and tool life on anyone conventional machining process.
10	Experiment on anyone advanced machining process
11	Design of Jigs and Fixture for any one application using any software tool.
12	Experiment using Drill/template Jig and Demonstration on turning and grinding fixtures.
13	Experiment using milling Indexing fixtures.

Course outcomes (Course Skill Set):

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

- Demonstrate the Conventional CNC machines and advanced manufacturing process operations
- Determine tool life, cutting force, and economy of the machining process.
- Analyze the influence of various parameters on machine tools' performance.
- Select the appropriate machine tools and process, the Jigs, and fixtures for various applications

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**)

- 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 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

1. Shaw, M C, (2014), Metal Cutting Principles, Oxford University Press.
2. McGeough, J A, (1988), Advanced Methods of Machining, Springer.
3. Boothroyd, G., and Knight, W. A., Fundamentals of Machining and Machine Tools, CRC Press.
4. Chattopadhyay, A B, (2013), Machining and Machine Tools, Wiley India.
5. Mikell P. Groover, (2019), Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley Publications.
6. Rao P. N., Manufacturing Technology II, Tata McGraw Hill

Web links and Video Lectures (e-Resources):

1. V. K. Jain, Advanced Machining Processes, NPTEL Course Department of Mechanical & Smart Manufacturing, IIT Kanpur, Link: http://nptel.ac.in/courses/112104028/.
2. U. S. Dixit, Mechanics of Machining, NPTEL Course Department of Mechanical & Smart Manufacturing Guwahati, Link: http://nptel.ac.in/courses/112103248/.
3. A. B. Chattopadhyay, Manufacturing Processes II, NPTEL Course of Department of Mechanical & Smart Manufacturing, IIT Kharagpur, https://nptel.ac.in/courses/112/105/112105126/.

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

- Visit any one machining center or machining industry and/or
- Case study on process parameter influence on anyone advanced machining process and hybrid machining process.

Fluid Mechanics and Heat Transfer		Semester	IV
Course Code	**BMM403**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**4:0:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40 hours Theory + 8-10 Lab slots**	Total Marks	100
Credits	**04**	Exam Hours	03
Examination nature (SEE)	**Theory**		

Course objectives:

- To have a working knowledge of the basic properties of fluids and to understand the concept of surface tension and capillarity.
- To study the kinematics of fluid and to understand the flow characteristic and dynamics of flow field for various engineering applications.
- Study the modes of heat transfer.
- Learn how to formulate and solve 1-D steady and unsteady heat conduction problems.
- Apply empirical correlations for fully-developed laminar, turbulent internal flows and external boundary layer convective flow problems.
- Study the basic principles of heat exchanger analysis and thermal design.
- Understand the principles of boiling and condensation including radiation heat transfer related to engineering problems..

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 **08 Hours**

Introduction and Fluid Properties: Definition of fluid, types of fluids, Properties of fluids-Mass density, Weight density, Specific volume, Specific gravity, Viscosity, Newton's law of viscosity, Phenomenon of surface tension and Capillarity. Simple numerical problems.

Fluid statics and Fluid Kinematics: Pascal's law and hydrostatic law. Total pressure and centre of pressure acting on a vertical and inclined submerged surface. Types of fluid flow, rate of flow, Continuity equation, velocity and acceleration, velocity potential function, stream function and simple numerical problems.

MODULE - 2 **08 Hours**

Fluid Dynamics: Equations of motion, Euler's Equation and Bernoulli's equation of motion. Momentum equation. Applications of Bernoulli's theorem such as venturi-meter, orifice meter (No derivation for discharge), rectangular and triangular notch, pitot tube. Viscous flow: viscous flow through circular pipes and between parallel pipes. simple numerical problems.

MODULE - 3 **08 Hours**

Introductory concepts and definitions: Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Types of boundary conditions. General three-dimensional Heat Conduction Equation: Steady-state one-dimensional heat conduction problems - slabs, cylinders and spheres (Without heat generation and Constant thermal conductivity). Simple numerical problems.

Brief Introduction to (No derivation and numerical): Variable thermal conductivity, heat generation, Thermal Resistances, Critical Thickness of Insulation in cylinder and spheres, Extended Surfaces or Fins, Fin Efficiency and Effectiveness, Applications, Transient heat conduction: Definition, Different cases.

MODULE - 4 **08 Hours**

Numerical Analysis of Heat Conduction: Introduction, one-dimensional steady conduction and one-dimensional unsteady conduction, boundary conditions, solution methods. **Thermal Radiation:** Fundamental principles - Gray, White, Opaque, Transparent and Black bodies, Spectral emissive power, Wien's displacement law, Planck's laws, Stefan-Boltzmann law, Emissivity and Kirchhoff's Laws, View factor, Net radiation exchange between parallel plates, Radiation Shield.

MODULE - 5 **08 Hours**

Convection: Newton's law of cooling, Dimensional analysis applied to forced and free convection, dimensionless numbers and their physical significance, empirical correlations for free and forced convection. Concepts of hydrodynamic and Thermal boundary layer.

Heat Exchangers: Definition, Classification, applications, LMTD method, Effectiveness - NTU method. (No Numerical)

Introduction to boiling and Condensation: Pool boiling, film wise and drop wise Condensation. (No Numerical)

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Determine the viscosity of oil using Red wood viscometer and Say-bolt viscometer.
2	Measurement of pressure using different Manometers for high and low pressure measurements (manometers using different manometric fluids).
3	Working principle of different flow meters and their calibration (orifice plate, venture meter, turbine, Rotameter, electromagnetic flow meter)
4	Working principle of different flow meters for open channel and their calibration
5	Determination of head loss in pipes and pipe fittings having different diameters, different materials and different roughness
6	Experiment to determine Thermal Conductivity of a metal rod
7	Experiment to find out overall heat transfer coefficient of composite wall
8	Experiment to find out emissivity of grey surface
9	Experiment to find out heat transfer coefficient for forced convection heat transfer
10	Experiment to find out heat transfer coefficient for natural convection heat transfer
11	Experiment to find out effectiveness of parallel and counter flow heat exchangers

12	Experiment to find out Stefan-Boltzmann constant

Course outcomes (Course Skill Set):

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

- Identify and calculate the key fluid properties used in the analysis of fluid behaviour.
- Apply the knowledge of fluid statics, kinematics and dynamics while addressing problems of Mechanical & Smart Manufacturing.
- Understand the modes of heat transfer and apply the basic laws to formulate engineering systems.
- Understand and apply the basic laws of heat transfer to extended surface and unsteady state heat transfer problems.
- Analyze heat conduction through numerical methods and apply the fundamental principle to solve radiation heat transfer problems.
- Analyze heat transfer due to free and forced convective heat transfer.
- Understand the design and performance analysis of heat exchangers and their practical applications, Condensation and Boiling phenomena.

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**)

- 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 scoredby 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:

Reference Books

1. Fox, R. W., Pitchard,P. J.,and McDonald, A. T., (2010), Introduction to Fluid Mechanics, 7thEdition, John Wiley & Sons Inc.
2. Cimbala, J.M., Cengel, Y. A. (2010),Fluid Mechanics: Fundamentals and Applications, McGraw-Hill
3. Frank M White., (2016), Fluid Mechanics, 8thEdition , McGraw-Hill
4. P K Nag., (2011), Heal and Mass Transfer, McGraw-Hill
5. Frank Kreith., (2011), Principles of Heat Transfer, 7th Edition, Cengage learning

Additional References:

1. A text book of Fluid Mechanics and Hydraulic Machines, Dr. R K Bansal, Laxmi publishers
2. Fundamentals of Fluid Mechanics, Munson, Young, Okiishi&Hebsch, John Wiley Publicationss, 7th Edition
3. Holman J P., (2008), Heat Transfer, Tata McGraw-Hill, 9th Edition.
4. Incropera F.P.., (2006), Fundamentals of Heat and Mass Transfer, 5th Edition

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/112/105/112105171/
- https://archive.nptel.ac.in/courses/112/105/112105269/
- https://onlinecourses.nptel.ac.in/noc22_ce85/preview
- https://nptel.ac.in/courses/112108149
- https://onlinecourses.nptel.ac.in/noc20_ch12/preview.

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

- Industrial visits
- Course seminar
- Term project

Sensors, Measurement and Metrology lab

Course Code	**BMML404**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**0-0-2*-0**	SEE Marks	50
Credits	**01**	Exam Hours	03

**** Additional one hour may be considered for instructions, if required***

Course objectives:

Students will be able

- To illustrate the theoretical concepts taught in Mechanical Measurements & Metrology through experiments.
- To illustrate the use of various measuring tools & measuring techniques.
- To understand calibration techniques of various measuring devices.

Modern computing techniques are preferred in estimation and analysis.

Sl.NO	Experiments
1	Study of instruments for Liner measurement and angular measurements: Slip gauges- Measurement of angle-sine bar, Sine centre, Angle gauges, Optical instruments for angular measurements.
2	Study of Autocollimator-Applications for measuring straightness and squareness.

3	Study of different Comparators and calibration of Dial indicator, Electrical comparators, LVDT, Pneumatic comparators
4	Study of Terminology of screw threads and Measurement of major diameter, Minor diameter, Pitch, Angle and Effective diameter of screw threads by 2- wire and 3-wire methods
5	Gear tooth measurement using Gear tooth Vernier and Parkinson Gear Tester
6	Various parameter measurement using computerized profile projector
7	Surface topology measurement using Surface Roughness Tester
8	Calibration of Pressure gauge, Thermocouple and Load cell
9	Determination of modulus of elasticity and modulus of rigidity of a mild steel specimen using strain gauges
10	Calibration of Micrometer and Vernier caliper using slip gauges
11	Circularity measurement using Electronic and Mechanical comparator
12	Demonstration of Measurement using Coordinate Measuring Machine (CMM) / Laser Scanner
13	Choose any product used in the day to day life based on his/her choice, prepare a measurement plan and implement the measurement with existing tools)

Course outcomes (Course Skill Set):

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

- Understand Calibration of pressure gauge, thermocouple, LVDT, load cell, micrometer.
- Apply concepts of Measurement of angle
- Demonstrate measurements using Optical Projector/Tool maker microscope, Optical flats.
- Analyse Screw thread parameters using 2-Wire or 3-Wire method, gear tooth profile using gear tooth Vernier/Gear tooth micrometre
- Understand the concepts of measurement of surface roughness.
- Demonstrate the use of Coordinate Measuring Machine (CMM) / Laser Scanner

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). 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 35% (18 Marks out of 50) in the semester-end examination(SEE).

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 8^{th} week of the semester and the second test shall be conducted after the 14^{th} 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. Rubrics suggested in Annexure-II of Regulation book
- 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, ***Internal examiner from the same institute and an external examiner from the other institute***, 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 15% Marks allotted to the procedure part to be made zero.
- The duration of SEE is 03 hours
- Rubrics suggested in Annexure-II of Regulation book.

Suggested Learning Resources:

Engineering Metrology and Measurements, N.V.Raghavendra and L. Krishnamurthy, Oxford University Press

Smart Materials & Systems		Semester	IV
Course Code	**BMM405A**	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	03
Examination type (SEE)	**Theory**		

Course objectives:

- To make the students understand about smart materials
- To make students to know about making of material smart
- To enable the students to appreciate the material properties

Teaching-Learning Process (General Instructions)

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

1. Class room teaching through chalk & talk, PPT, Appropriate Videos, etc
2. Industry visit
3. Activity based learning
4. Display the sample materials in class room / laboratory

Module-1

Smart materials and structures: System intelligence- components and classification of smart structures, common smart materials and associated stimulus-response, Application areas of smart systems

Module-2

Electrically Activated Materials: Piezoelectricity, Piezo resistivity, Ferroelectricity, Piezoelectric materials-piezoelectric effect, Piezo ceramics, Piezo polymers, Piezoelectric materials as sensors, Actuators and bimorphs, Nano carbon tubes

Module-3

Thermally activated materials: Shape memory materials; Shape memory alloys (SMAs), Classification - Transformation - Ni-Ti Alloys, Shape memory effect, Martensitic transformation, One way and two-way SME, binary and ternary alloy systems, Functional properties of SMAs, Shape memory ceramics - Shape memory polymers – Applications
Module-4
Smart polymers: Thermally responsive polymers, Electroactive polymers micro gels, Synthesis, Properties and Applications, Protein-based smart polymers, pH-responsive and photo-responsive polymers, Self-assembly, Drug delivery using smart polymers.
Module-5
Chemically Activated Materials - Chemical Gels - Self healing materials Optically Activated Materials - Optically activated polymers - Azobenzene - Liquid Crystal, Smart materials for space applications: Elastic memory composites, Smart corrosion protection coatings, Sensors, Actuators, Transducers,

Course outcome (Course Skill Set)

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

1. Apply the knowledge for materials characterisation
2. Evaluate the materials based on actuation
3. Select and justify appropriate materials for 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:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 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 assignment 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.

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. D.J. Leo, Engineering Analysis of Smart Material Systems, Wiley 2007.
2. M. Addington, D.L. Schodek, Smart Materials and New Technologies in Architecture, Elsevier 2005.
3. Donald R. Askeland and Pradeep P. Fulay, Essentials of Materials Science and Engineering, 2009, Cengage Laerning.

References

1. Gandi, M.V. and Thompson, B.S., "Smart Materials and Structures," Chapman & Hall, UK, 1992,
2. Culshaw, B., "Smart Structures and Materials," Artech House, Inc., Norwood, USA, 1996.
3. Dimitris C. Lagoudas, Shape Memory Alloys: Modelling and Engineering Applications, Springer, 2008.
4. T. Yoneyama & S. Mayazaki, Shape memory alloys for biomedical applications, CRCPress, 2008

Web links and Video Lectures (e-Resources):

- Smart materials intelligent system design NPTEL course

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

- Prepare a smart material sample
- Visit to industry

Micro and Smart System Technology		Semester	IV
Course Code	**BMM405B**	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	03
Examination type (SEE)	Theory		

Course objectives:

- Gain knowledge of Smart Materials, Sensors & Actuators, Microsystems.
- Understand the Operation of Smart Devices & Systems, Electronic Circuits & Control for MEMS, Methodology of Micro-manufacturing

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.

Module-1 **08 Hours**

Introduction to Micro and Smart systems :Miniaturization, Microsystems versus MEMS, Micro-fabrication, Smart Materials, Structures & Systems, Integrated Microsystems ,Application of Smart Materials & Microsystems.

Module-2 **08 Hours**

Micro and Smart Devices and Systems: Principles and Materials: Definitions and salient features of sensors, actuators, and systems. Sensors: silicon capacitive accelerometer, piezo-resistive pressure sensor, Portable blood analyzer, conduct metric gas sensor. Actuators: Micro mirror Array for Video Projection, Piezoelectric based ink-jet print head, electrostatic comb-drive, and Magnetic micro relay experimental modal analysis, machine condition monitoring and diagnosis.

Module-3 **08 Hours**

Micromachining Technologies: Silicon as a Material for Micromachining, Silicon wafer preparation, thin-film deposition techniques, Lithography, Etching, Silicon micro machining: surface micromachining, bulk micromachining. Specialized Materials for Microsystems.

Module-4	08 Hours
Electronics Circuits for Micro and Smart Systems. Semiconductor devices: Diode, Schottky diode,Tunnel diode,BJT ,MOSFET,CMOS circuits ,Electronics Amplifiers ,Op-Amp based circuits .	
Module-5	**08 Hours**
Implementation of Controllers for MEMS & Case Studies of Integrated Microsystems. Design Methodology, PID controller, Circuit Implementation, Digital controller, Microcontroller & PLC. Case Studies of Integrated Microsystems: BEL pressure sensor, design considerations, performance parameters, and Smart Structure in vibration control.	

Course outcome (Course Skill Set)

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

- Have knowledge of Smart Materials, Sensors &Actuators ,Microsystems.
- Understand the Working Methodology of Smart Devices & Systems, Electronic Circuits & Control for MEMS, Methodology of Micro-manufacturing

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 Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 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 assignment 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.

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 Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

- The question paper will have ten questions. Each question is set for 10 marks.
- There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
- The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Text Books:

- Micro and Smart Systems G.K.Ananthasuresh, K.J.Vinoy, S.Gopalakrishnan, K.N.Bhat, V.K.Aatre Wiley India 2010
- Design and Development Methodogies, Smart Material Systems and MEMS V. Varadan, K. J. Vinoy, S. Goplakrishnan Wiley India
- MEMS Nitaigour Premchand Mahalik, TMH 2007
- MEMS & Microsystems Design and Manufacture Tai-Ran Hsu Tata Mc-Graw-Hill

- Mechanical Vibrations and Noise engineering Amberkar A.G. PHI

Web links and Video Lectures (e-Resources):

https://archive.nptel.ac.in/courses/112/108/112108092/
https://nptel.ac.in/courses/112108092
https://archive.nptel.ac.in/content/syllabus_pdf/112108092.pdf
https://nptelvideos.com/discipline.php?name=Mechanical-Engineering

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

- Quizzes
- Assignments
- Seminars

Management Information Systems		Semester	IV
Course Code	**BMM405C**	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	03
Examination type (SEE)	**Theory**		

Course objectives:

- To provide students with basic concepts in information system and the benefits with these systems in modern society.
- Differentiate between data, information, and knowledge.
- To understand systems definition, systems requirements, and information needed for decision maker.
- To identify several methods to enhance and develop information systems and to manage the information system recourses.

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.

Module-1	**08 Hours**
Introduction and Organizational Systems: Definition, importance, evolution, computers and MIS organizational structures, Logical foundation, future of MIS. Nature and Characteristics of organizations.	
Module-2	**08 Hours**
Information Systems and Communication Technology: Organizational and information system structures, information, data information, management and information systems. Information support for functional areas, impact of business and information systems, organizing information systems, absorption of MIS in organizations.	
Module-3	**08 Hours**
Database Technology: Data base and enterprise management, File processing systems and data base systems, Database Approach and its architecture, DBMS, Models, RDBMS, SQL, 4GL, Data Administration, Current development in databases.	
Module-4	**08 Hours**
Decision Support Systems: Definition, Evolution of DSS, DSS issues, Structure Constructions-approaches, Generators, Tools, Software and Cost benefits.	
Module-5	**08 Hours**
Expert Systems and Artificial Intelligence: Basic Concepts, Structure development, Benefits and Limitations.	

Course outcome (Course Skill Set)

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

- Explain the importance of determining information system requirements for all management levels by describing the differences between various types of information systems.

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:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 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 assignment 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.

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:

Text Books:

1. L .S. Sadagopan,"Management Information Systems," Prentice Hall of India New Delhi, 1997, ISBN 9788120311800
2. "Davis G.B and M.Olson, " Management Information Systems," McGraw Hill New York, 2nd Edition, 1985, ISBN: 9780070158283.
3. O'brienJ .A Jr., "Management Information Systems" McMillan, New York, 1995.
4. Date C.J, "An Introduction to Database Systems," Pearson, 8th Edition, 22nd July 2003, ISBN: 978-0321197849.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program
- https://onlinecourses.nptel.ac.in/noc20_mg60/preview
- https://archive.nptel.ac.in/courses/110/105/110105148/

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

- Case studies
- Quiz
- Topic Seminar presentation
- Assignments

Ability Enhancement Course/Skill Enhancement Course - IV			
QUALITY ENGINEERING			
Course Code	**BMM456A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**0:2:0:0**	SEE Marks	50
Total Hours of Pedagogy	**30**	Total Marks	100
Credits	**01**	Exam Hours	01

Course objectives:

- To impart knowledge on inspection, measurement, quality control, validation and certification of products.

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	
Basic concepts: Measurement and inspection; Role of metrology in quality assurance; Errors; Length standards; Gauges and comparators; Linear and angular measurements; Fits and tolerances.	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Module-2	
Measurement Practices: Optical metrology and laser interferometers; Measurement of flatness, straightness and form errors; Surface finish measurements.	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Module-3	
CMM; Vision applications in Metrology; Nano-measurements.	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Module-4	
Statistical Methodologies: Graphical methods, Statistical control charts, Regression analysis, Analysis of variance, Sampling and acceptance.	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-5	
Standards and Certifications: BIS, ISO, SAE, ASME, ASTM, IEEE. Case studies: Inspection and Validation practices adopted in various industries.	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Course outcome (Course Skill Set)

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

1. Understand various metrology principles and techniques
2. Identify and select suitable techniques and equipments to inspect and to ensure product quality
3. Explain about various quality control methodologies, standards and certifications.

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). 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 35% (18 Marks out of 50) in the semester-end examination(SEE), and 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 Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 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 assignment 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.

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 Examinations (SEE)

- SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.**
- The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. T. G. Beckwith, R. D. Marangoni and J. H. Lienhard, Mechanical Measurements, 6th edition, Pearson Higher Education, 2007, ISBN: 0132296071.
2. R. K. Jain, Engineering Metrology, Khanna Publishers, 20th Reprint, 2014, ISBN: 817409153X.

References

1. D. J. Whitehouse, Hand book of surface and nanometrology, 2nd Edition, CRC Press, 2010, ISBN: 9781420082012.
2. G. T. Smith, Industrial Metrology, Springer, 2002, ISBN: 9781852335076.
3. A. M. Badadhe, Metrology and Quality Control, Technical Publications, 2006, ISBN: 8189411861
4. R. C. Gupta, Statistical Qualtiy Control, 8th edition, Khanna Publishers, 2008, ISBN: 8174091114.

Web links and Video Lectures (e-Resources):

https://onlinecourses.swayam2.ac.in/nou21_me04/preview
https://nptel.ac.in/courses/110105088
https://onlinecourses.nptel.ac.in/noc20_mg18/preview
https://nptel.ac.in/courses/110104080

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

- Course seminars
- Topic Seminar presentation
- Assignments

Ability Enhancement Course/Skill Enhancement Course - IV			
MECHANICAL DESIGN CONCEPTS			
Course Code	**BMM456B**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**0:2:0:0**	SEE Marks	50
Total Hours of Pedagogy	**30**	Total Marks	100
Credits	**01**	Exam Hours	01

Course objectives:

- This is a basic course on mechanical engineering design focusing on the principles of design, load analysis, stress analysis and final failure analysis of mechanical systems.

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	
Kinematics and Dynamics: Introduction to mechanisms; position, velocity and acceleration of planar mechanisms; dynamics of planar mechanisms; case studies	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Module-2	
Stress and Strain – axially loaded members; torsion of circular bars; bending of prismatic beams	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Module-3	
Failure Theories – failure of ductile and brittle materials under static loading; mechanism of fatigue failures; fatigue failure models;	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Module-4	
Machine Elements – Design of non-permanent joints - threaded fasteners, mechanics of power screws;	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-5	
Design of permanent joints – welding; gears – nomenclature, force analysis, Lewis bending equation, design of spur and helical gears.	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Course outcome (Course Skill Set)

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

Students would be able to apply basic concepts related to mechanical design to design various mechanical systems in aerospace, automotive, naval, wind energy, chemical (nuclear) reactor, oil exploration, solid and fluid transportation

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). 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 35% (18 Marks out of 50)in the semester-end examination(SEE), and 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 Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 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 assignment 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.

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 Examinations (SEE)

- SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.**
- The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

- L. Norton, Machine Design – an integrated approach, 5th edition, Pearson education Inc., 2014. ISBN-13: 9780133356717.
- J. E. Shigley, C. R. Mischke and R. G. Budynas, Mechanical Engineering Design, 7th edition McGraw-Hill, 2004. ISBN-13: 978-0071232708.

References

- R. C. Juvinall and K. M. Marshek, Fundamentals of Machine Component Design, 5th edition, Wiley-India, 2011. ISBN-13: 978-1118012895.
- M. F. Spotts, T. E. Shoup and L. E. Hornberger, Design of Machine Elements, 8th edition, Pearson education Inc., 2003. ISBN-13: 9780130489890.
- A. K. Mallik, A. Ghosh and G. Dittrich, Kinematic analysis and synthesis of mechanisms, 1st edition, CRC Press, ISBN: 0-8493-9121-0.

Web links and Video Lectures (e-Resources):

https://archive.nptel.ac.in/courses/112/105/112105124/

https://archive.nptel.ac.in/courses/112/101/112101005/

https://archive.nptel.ac.in/courses/112/106/112106137/

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

- Course seminars
- Topic Seminar presentation
- Assignments

Ability Enhancement Course/Skill Enhancement Course - IV			
SPECIAL MANUFACTURING PROCESSES			
Course Code	**BMM456C**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**0:2:0:0**	SEE Marks	50
Total Hours of Pedagogy	**30**	Total Marks	100
Credits	**01**	Exam Hours	01

Course objectives:

- To learn about various unconventional machining processes, process parameters and their influence on performance and their applications.

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	
unconventional machining:An Overview of unconventional machining, need, classification and selection. Process that make use of mechanical energy such as ultrasonic machining, water jet and abrasive jet machining methods.	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Module-2	
Electrochemical and Chemical Metal Removing Processes: electrochemical machining, electrochemical honing, electrochemical grinding, and chemical machining.	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Module-3	
Thermal Metal Removal Processes methods: plasma arc machining, neutral particle etching,electric discharge machining, hot machining, electron beam machining and laser beam machining.	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Module-4	
Milling Machine Exercises : Simple prismatic parts, Contour milling using vertical milling machine, Spur gear cutting in milling machine and Helical Gear Cutting in milling machine	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board
Module-5	

Grinding Exercises: Plain Surface grinding, Cylindrical grinding Measurement of cutting forces in Milling / Turning Process EDM, Laser cutting and Rapid Prototyping

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Course outcome (Course Skill Set)

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

1. Identify the necessity of "Special manufacturing Process"
2. Define with examples the concept of "Special manufacturing"
3. List the main classifications of the manufacturing processes with examples

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). 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 35% (18 Marks out of 50)in the semester-end examination(SEE), and 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 Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 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 assignment 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.

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 Examinations (SEE)

- SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.**
- The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. S. Kalpakjian, S. R. Schmidt, Manufacturing Engineering and Technology, 7th edition, Pearson India, 2009. ISBN: 978-0133128741
2. E. P. DeGarmo, J. T. Black, and R. A. Kohser, DeGarmo's materials and processes in manufacturing, 11th edition, John Wiley & Sons, 2013. ISBN: 978-8126540464

References

1. M. P. Groover, Principles of Modern Manufacturing, 5th edition, Wiley, 2014. ISBN: 978-812654737

Web links and Video Lectures (e-Resources):

https://archive.nptel.ac.in/courses/112/107/112107219/
https://nptel.ac.in/courses/112107144
https://nptel.ac.in/courses/112107219
https://onlinecourses.nptel.ac.in/noc22_me28/preview

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

- Course seminars
- Topic Seminar presentation
- Assignments