KALINGA UNIVERSITY, NAYA RAIPUR, CHHATTISGARH

Evaluation Scheme & Syllabus for
B. Tech.

(Mechanical Engineering)

AS PER

AICTE MODEL CURRICULUM

UNDER

Faculty of Engineering
w.e.f. Session 2021-22

KALINGA UNIVERSITY NAYA RAIPUR
Bachelor of Technology (Mechanical Engineering)
w.e.f Academic Session 2021-22

B-Tech(ME) 1st Semester							
Subject Code	**Subject**	**L**	**T/P**	**Credits**	**End semester Exam**	**Internal Marks**	**Total**
BTME101	**Programming for Problem Solving**	3	0	3	70	30	100
BTME102	**Emerging Domain in Electronics Engineering**	3	0	3	70	30	100
BTME103	**Engineering Chemistry**	3	1	4	70	30	100
BTME104	**Engineering Mathematics- I**	3	1	4	70	30	100
BTME105	**English**	2	0	2	70	30	100
BTME106-P	**Engineering Chemistry -Lab**	0	2	1	30	20	50
BTME107-P	**Emerging Domain in Electronics Engineering-Lab**	0	2	1	30	20	50
BTME108-P	**Programming for Problem Solving-Lab**	0	2	1	30	20	50
BTME109-P	**Mechanical Workshop- Lab**	0	2	1	30	20	50
Total		**14**	**10**	**20**	**470**	**230**	**700**

B-Tech(ME) 2nd Semester							
Subject Code	**Subject**	**L**	**T/P**	**Credits**	**End semester Exam**	**Internal Marks**	**Total**
BTME201	**Fundamentals of Mechanical Engineering & Mechatronics**	3	0	3	70	30	100
BTME202	**Basic Electrical Engineering**	3	0	3	70	30	100
BTME203	**Engineering Physics**	3	1	4	70	30	100
BTME204	**Engineering Mathematics- II**	3	1	4	70	30	100

BTME205	**Artificial Intelligence for Engineers**	2	0	2	30	20	50
BTME206P	**Engineering Physics -Lab**	0	2	1	30	20	50
BTME207P	**Basic Electrical Engineering-Lab**	0	2	1	30	20	50
BTME208P	**English Language-Lab**	0	2	1	30	20	50
BTME209P	**Engineering Graphics & Design-Lab**	0	2	1	30	20	50
Total		**14**	**10**	**20**	**470**	**230**	**700**

*The Mini Project or internship (3-4 weeks) conducted during summer break after II semester and will be assessed during III semester.

B.Tech(ME)- Third Semester							
Subject Code	**Subject**	**Lecture**	**Tutorial/ Practical**	**Credits**	**End semester Exam**	**Internal Marks**	**Total**
BTME301	**Maths-III**	3	1	4	70	30	100
BTMS302	**Technical Communication**	3	0	3	70	30	100
BTME303	**Thermodynamics**	3	1	4	70	30	100
BTME304	**Engineering Mechanics**	3	1	4	70	30	100
BTME305	**Materials Engineering**	3	1	4	70	30	100
BTME306P	**Engineering Mechanics - Lab**	0	2	1	30	20	50
BTME307P	**Material Testing-Lab**	0	2	1	30	20	50
BTME308P	**Computer Aided Machine Drawing-I**	0	2	1	30	20	50
BTME309P	**Mini Project or Internship Assessment***	0	2	2	30	20	50
Total		**15**	**12**	**24**	**470**	**230**	**700**

B.Tech (ME) -Fourth Semester							
Subject Code	**Subject**	**Lecture**	**Tutorial/ Practical**	**Credits**	**End semester Exam**	**Internal Marks**	**Total**
BTME401	**Measurement &** Metrology	3	0	3	70	30	100
BTME402	**Universal Human Values**	3	0	3	70	30	100
BTME403	**Applied Thermodynamics**	3	0	3	70	30	100
BTME404	**Fluid Mechanics & Fluid Machines**	3	1	4	70	30	100
BTME405	**Manufacturing Process**	3	1	4	70	30	100
BTME406P	**Applied Thermodynamics-Lab**	0	2	1	30	20	50
BTME407P	**Manufacturing Process-Lab**	0	2	1	30	20	50
BTME408P	**Fluid Machines-Lab**	0	2	1	30	20	50
BTME409P	Measurement & Metrology -Lab	0	2	1	30	20	50
Total		**15**	**10**	**21**	**470**	**230**	**700**

*****The internship (6 weeks) conducted during summer break after IV semester and will be assessed during V semester.

B.Tech(ME)- Fifth Semester							
Subject Code	**Subject**	**Lecture**	**Tutorial/ Practical**	**Credits**	**End semester Exam**	**Internal Marks**	**Total**
BTME501	Heat and Mass Transfer	3	1	4	70	30	100
BTME502	Strength of Material	3	1	4	70	30	100
BTME503	Industrial Engineering	3	1	4	70	30	100
BTME504	**Departmental Elective-I**	3	0	3	70	30	100
BTME504A	Computer Integrated Manufacturing						
BTME504B	Mechatronics Systems						
BTME504C	Finite Element Methods						
BTME504D	I C Engine Fuel and Lubrication						
BTME504E	Automobile Engines & Combustion						
BTME505	**Departmental Elective-II**	3	0	3	70	30	100
BTME505A	Advance welding						
BTME505B	Programming, Data Structures And Algorithms Using Python						
BTME505C	Mechanical Vibrations						
BTME505D	Fuels and Combustion						
BTME505E	Automotive chassis and suspension						
BTME506P	**Heat and Mass Transfer Lab**	0	2	1	30	20	50
BTME507P	**Computer Aided Machine Drawing-II-Lab**	0	2	1	30	20	50
BTME508P	Automobile Engineering-Lab	0	2	1	30	20	50
BTME509P	Internship Assessment*	0	2	2	30	20	50
Total		**15**	11	**23**	**470**	**230**	**700**

B.Tech(ME)- Sixth Semester							
Subject Code	**Subject**	**Lecture**	**Tutorial/ Practical**	**Credits**	**End semester Exam**	**Internal Marks**	**Total**
BTME601	Refrigeration and Air Conditioning	3	1	4	70	30	100
BTME602	Machine Design	3	1	4	70	30	100
BTME603	Theory of Machine	3	1	4	70	30	100
BTME604	**Departmental Elective-III**	3	0	3	70	30	100
BTME604A	Non destructive Testing						
BTME604B	Artificial Intelligence						
BTME604C	Tribology						
BTME604D	Gas Dynamics and Jet Propulsion						
BTME604E	Automotive Electrical and Electronics						
BTOE605	**Open Elective-I**	3	0	3	70	30	100
BTOE605A	Real Time Systems						
BTOE605B	Embedded System						
BTOE605C	Introduction To Mems						
BTOE605D	Object Oriented Programming						
BTOE605E	Numerical Techniques						
BTOE605F	GIS & Remote Sensing						
BTOE605G	Understanding The Human Being Comprehensively- Human Aspirations And Its Fulfillment						
BTME606P	Refrigeration and Air Conditioning Lab	0	2	1	30	20	50
BTME607P	Machine Design Lab	0	2	1	30	20	50
BTME608P	Theory of Machine Lab	0	2	1	30	20	50
Total		**15**	**9**	**21**	**440**	**210**	**650**

*****The internship (6 weeks) conducted during summer break after VI semester and will be assessed during VII semester.

B-Tech(ME) 7th Semester							
Subject Code	**Subject**	**L**	**T/P**	**Credits**	**End Semester Exam**	**Internal Marks**	**Total**
BTME701	CAD/CAM	3	1	4	70	30	100
	Departmental Elective-IV	3	0	3	70	30	100
BTME702A	Power Plant Engineering						
BTME702B	Additive Manufacturing						
BTME702C	Vehicle Body Engineering and Safety						
	Departmental Elective-V	3	0	3	70	30	100
BTME703A	Automation & Robotics						
BTME703B	Modelling & Simulation						
BTME703C	Computational Fluid Dynamics						
BTME703D	Automotive Transmission						
BTME703E	Lean Manufacturing						
	Open Elective-II	3	0	3	70	30	100
BTMEOE704A	Digital & Social Media Marketing						
BTMEOE704B	Idea to Business Model						
BTMEOE704C	Machine Learning						
BTMEOE704D	Renewable Energy Resources						
BTMEOE704E	Operation Research						
BTMEOE704F	Value Relationship & Ethical Human Conduct –For A Happy & Harmonious Society						
BTME705P	CAD/CAM-Lab	0	2	1	30	20	50
BTME706P	Minor Project	0	6	3	100	50	150
BTME707P	Internship Assessment	0	2	2	30	20	50
Total		**12**	**11**	**19**	**440**	**210**	**650**

B-Tech(ME) 8th Semester							
Subject Code	**Subject**	**L**	**T/P**	**Credits**	**End Semester Exam**	**Internal Marks**	**Total**
BTME801	Project Management & Entrepreneurship	3		3	70	30	100
	Departmental Elective-VI	3		3	70	30	100
BTME802A	Flexible Manufacturing System						
BTME802B	Advance Manufacturing Science						
BTME802C	Hybrid Vehicle Propulsion						
	Open Elective-III	3		3	70	30	100
BTMEOE803A	Filter Design						
BTMEOE803B	Bioeconomics						
BTMEOE803C	Design Thinking						
BTMEOE803D	Introduction to Women's & Gender Studies						
BTMEOE803E	Quality Management						
BTMEOE803F	Modeling of Field Effects Nano Devices						
BTMEOE803G	Computerized Process Control						
BTME804P	Project	0	18	9	200	100	300
Total		**9**	**18**	**18**	**410**	**190**	**600**

SEMESTER I

Programming for Problem Solving

BTME101

Course Outcomes

1. To develop simple algorithms for arithmetic and logical problems.
2. To translate the algorithms to programs & execution (in C language).
3. To implement conditional branching, iteration and recursion.
4. To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
5. To use arrays, pointers and structures to develop algorithms and programs.

Module – 1 : **(Introduction to Programming)** **[08]**

Introduction to components of a computer system: Memory, processor, I/O Devices, storage, operating system, Concept of assembler, compiler, interpreter, loader and linker.

Idea of Algorithm: Representation of Algorithm, Flowchart, Pseudo code with examples, From algorithms to programs, source code.

Programming Basics: Structure of C program, writing and executing the first C program, Syntax and logical errors in compilation, object and executable code. Components of C language. Standard I/O in C, Fundamental data types, Variables and memory locations, Storage classes.

Module – 2 : **(Arithmetic expressions & Conditional Branching)** **[08]**

Arithmetic expressions and precedence: Operators and expression using numeric and relational operators, mixed operands, type conversion, logical operators, bit operations, assignment operator, operator precedence and associativity.

Conditional Branching: Applying if and switch statements, nesting if and else, use of break and default with switch.

Module – 3 : **(Loops & Functions)**

Iteration and loops: use of while, do while and for loops, multiple loop variables, use of break and continue statements.

Functions: Introduction, types of functions, functions with array, passing parameters to functions, call by value, call by reference, recursive functions.

Module – 4 : **(Arrays & Basic Algorithms)** **[08]**

Arrays: Array notation and representation, manipulating array elements, using multi dimensional arrays. Character arrays and strings, Structure, union, enumerated data types, Array of structures, Passing arrays to functions.

Basic Algorithms: Searching &Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, Notion of order of complexity.

Module – 5 :**(Pointer& File Handling)** **[08]**

Pointers: Introduction, declaration, applications, Introduction to dynamic memory allocation (malloc, calloc, realloc, free), Use of pointers in self-referential structures, notion of linked list (no implementation)

File handling: File I/O functions, Standard C preprocessors, defining and calling macros, command-line arguments.

Text books:

1. Schum‟s Outline of Programming with C by Byron Gottfried, McGraw-Hill.
2. The C programming by Kernighan Brain W. and Ritchie Dennis M., Pearson Education.
3. Computer Basics and C Programming by V.Rajaraman , PHI Learning Pvt. Limited,2015
4. Computer Concepts and Programming in C, R.S. Salaria, Khanna Publishing House
5. Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill
6. Computer Science- A Structured Programming Approach Using C, by Behrouz
7. A. Forouzan, Richard F. Gilberg, Thomson, Third Edition , Cengage Learning – 2007.
8. Let Us C By Yashwant P. Kanetkar.
9. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson.
10. Programming in C by Kochan Stephen G. Pearson Education – 2015.
11. Computer Concepts and Programming in C by D.S. Yadav and Rajeev Khanna, New AgeInternational Publication.
12. Problem Solving and Programming in C, R.S. Salaria, Khanna Publishing House

Programming for Problem Solving Lab

BTME108P

Course Outcomes

1. To write programs for arithmetic and logical problems.
2. To translate the algorithms to programs & execution (in C language).
3. To write programs for conditional branching, iteration and recursion.
4. To write programs using functions and synthesize a complete program using divide and conquer approach.
5. write programs using arrays, pointers and structures.

Other Reference: - Use C Open Source Software referring Spoken Tutorial MOOC

1. WAP that accepts the marks of 5 subjects and finds the sum and percentage marks obtained by the student.
2. WAP that calculates the Simple Interest and Compound Interest. The Principal, Amount, Rate of Interest and Time are entered through the keyboard.
3. WAP to calculate the area and circumference of a circle.
4. WAP that accepts the temperature in Centigrade and converts into Fahrenheit using the formula C/5=(F-32)/9.
5. WAP that swaps values of two variables using a third variable.
6. WAP that checks whether the two numbers entered by the user are equal or not.
7. WAP to find the greatest of three numbers.
8. WAP that finds whether a given number is even or odd.
9. WAP that tells whether a given year is a leap year or not.
10. WAP that accepts marks of five subjects and finds percentage and prints grades according to the following criteria:
    Between 90-100%---------- Print „A"
    Between 80-90%---------- Print „B"
    Between 60-80%---------- Print „C"
    Between Below 60%---------- Print „D"
11. WAP that takes two operands and one operator from the user and perform the operation and prints the result by using Switch statement.
12. WAP to print the sum of all numbers up to a given number.
13. WAP to find the factorial of a given number.
14. WAP to print sum of even and odd numbers from 1 to N numbers.
15. WAP to print the Fibonacci series.
16. WAP to check whether the entered number is prime or not.
17. WAP to find the sum of digits of the entered number.
18. WAP to find the reverse of a number.
19. WAP to print Armstrong numbers from 1 to 100.
20. WAP to convert binary number into decimal number and vice versa.
21. WAP that simply takes elements of the array from the user and finds the sum of these elements.
22. WAP that inputs two arrays and saves sum of corresponding elements of these arrays in a third array and prints them.
23. WAP to find the minimum and maximum element of the array.
24. WAP to search an element in a array using Linear Search.
25. WAP to sort the elements of the array in ascending order using Bubble Sort technique.
26. WAP to add and multiply two matrices of order nxn.

27. WAP that finds the sum of diagonal elements of a mxn matrix.
28. WAP to implement strlen (), strcat (),strcpy () using the concept of Functions.
29. Define a structure data type TRAIN_INFO. The type contain Train No.: integer type Train name: string Departure Time: aggregate type TIME Arrival Time: aggregate type TIME Start station: string End station: string The structure type Time contains two integer members: hour and minute. Maintain a train timetable and implement the following operations:
    (i) List all the trains (sorted according to train number) that depart from a particular section.
    (ii) List all the trains that depart from a particular station at a particular time.
    (iii) List all he trains that depart from a particular station within the next one hour of a given time.
    (iv) List all the trains between a pair of start station and end station.
30. WAP to swap two elements using the concept of pointers.
31. WAP to compare the contents of two files and determine whether they are same or not.
32. WAP to check whether a given word exists in a file or not. If yes then find the number of times it occurs.

EMERGING DOMAIN IN ELECTRONICS ENGINEERING

(BTME102)

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Understand the concept of PN Junction and devices.
2. Understand the concept of BJT, FET and MOFET.
3. Understand the concept of Operational amplifier
4. Understand the concept of measurement instrument.
5. Understand the working principle of different type of sensor and their uses.
6. Understand the concept of IoT system & Understand the component of IoT system

Unit	Topics	Lectures
I	**Semiconductor Diode**: Depletion layer, V-I characteristics, ideal and practical Diodes, Diode Equivalent Circuits, Zener Diodes breakdown mechanism (Zener and avalanche)	**3**
	Diode Application: Diode Configuration, Half and Full Wave rectification, Clippers, Clampers, Zener diode as shunt regulator, Voltage-Multiplier Circuits	**3**
	Special Purpose two terminal Devices: Light-Emitting Diodes, Photo Diodes, Varactor Diodes, Tunnel Diodes, Liquid-Crystal Displays.	**2**
II	**Bipolar Junction Transistor:** Transistor Construction, Operation, Amplification action. Common Base, Common Emitter, Common Collector Configuration	**4**
	Field Effect Transistor: Construction and Characteristic of JFETs. Transfer Characteristic. MOSFET (MOS) (Depletion and Enhancement) Type, Transfer	**4**
III	**Operational Amplifiers:** Introduction, Op-Amp Basic, Practical Op-Amp Circuits (Inverting Amplifier, Non-inverting Amplifier, Unit Follower, Summing Amplifier, Integrator, Differentiator).Differential and Common-Mode Operation, Comparators.	**4**
	Introduction of IoT System, Components of IoT system: Microprocessor and Microcontroller, Bluetooth Technology, Wi-Fi Technology, Concept of Networking, Sensor Nodes, concept of cloud.	**4**
IV	**Digital Electronics:** Number system & representation. Introduction of Basic and Universal Gates, using Boolean algebra simplification of Boolean function. K Map Minimization upto 6 Variable.	**6**
	Introduction To IC Technology: SSI, MSI, LSI, VLSI Integrated Circuits.	**2**
V	**Fundamentals of Communication Engineering:** Basics of signal representation and analysis, Electromagnetic spectrum Elements of a Communication System, Need of	**4**

modulation and typical applications, Fundamentals of amplitude modulation and demodulation techniques.

Introduction to Data Communications: Goals and applications of Networks.

General Model of Wireless Communication: Evolution of mobile radio communication fundamentals, GPRS, GSM, CDMA. Elements of Satellite & Radar Communication, **4**

Text Books:

1. Robert L. Boylestand / Louis Nashelsky "Electronic Devices and Circuit Theory", Pearson Education.
2. H S Kalsi, "Electronic Instrumentation", McGraw Publication
3. George Kennedy, "Electronic Communication Systems", McGraw Publication
4. David A. Bell, "Electronic Devices and Circuits", Oxford University Press.
5. Jacob Millman, C.C. Halkias, Staya brataJit, "Electronic Devices and Circuits", McGraw Hill
6. David A. Bell, Electronic Instrumentation and Measurements, Latest Edition, Oxford University Press India

EMERGING DOMAIN IN ELECTRONICS ENGINEERING-Lab

(BTME107P)

Suggestive List of Experiments:

Part A

1. Study of various types of Active & Passive Components based on their ratings.
2. Identification of various types of Printed Circuit Boards (PCB) and soldering Techniques.
3. PCB Lab: a. Artwork & printing of a simple PCB. b. Etching & drilling of PCB
4. Winding shop: Step down transformer winding of less than 5VA.
5. Soldering shop: Soldering and disordering of Resistor in PCB. Soldering and disordering of IC in PCB. Soldering and disordering of Capacitor in PCB

Part B

1. Study of Lab Equipments and Components: CRO, Multimeter, and Function Generator, Power supply- Active, Passive Components and Bread Board.
2. P-N Junction diode: Characteristics of PN Junction diode - Static and dynamic resistance measurement from graph.
3. Applications of PN Junction diode: Half & Full wave rectifier- Measurement of Vrms, Vdc, and ripple factor.
4. Characteristics of Zener diode: V-I characteristics of zener diode, Graphical measurement of forward and reverse resistance.
5. Characteristic of BJT: BJT in CE configuration.
6. To study Operational Amplifier as Adder and Subtractor
7. Verification of Truth Table of Various Logic Gate.
8. Implementation of the given Boolean function using logic gates in both SOP and POS forms.

ENGINEERING CHEMISTRY

BTME103

Course Outcomes:

1. Use of different analytical instruments.
2. Measure molecular/system properties such as surface tension, viscosity, conductance of solution, chloride and iron content in water.
3. Measure hardness of water.
4. Estimate the rate constant of reaction.

Module-1 **[08]**

Atomic and Molecular Structure:

Molecular orbital's of diatomic molecules. Band theory of solids. Liquid crystal and its applications. Point defects in solids. Structure and applications of Graphite and Fullerenes. Concepts of Nanomaterials and its application.

Module-2 **[08]**

Spectroscopic techniques and Applications:

Elementary idea and simple applications of Rotational, Vibrational, Ultraviolet& Visible and Raman spectroscopy.

Module-3 **[08]**

Electrochemistry

Nernst Equation and application, relation of EMF with thermodynamic functions (ΔH, ΔF and ΔS). Lead storage battery. Corrosion; causes, effects and its prevention. Phase Rule and its application to water system.

Module-4 **[08]**

Water Analysis; Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method).

Fuels: classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeterand Dulong'smethos).

Module-5 **[08]**

Polymer; Basic concepts of polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (Buna-S, Buna-N, Neoprene, Nylon-6, nylon-6,6 and Terylene) . General methods of synthesis of organometallic compounds (Grignard reagent) and their applications.

Reference Books:

1. University Chemistry By B.H. Mahan
2. University Chemistry By C.N.R. Rao
3. Organic Chemistry By I.L. Finar
4. Physical Chemistry By S. Glasstone
5. Engineering Chemistry By S.S. Dara
6. Polymer Chemistry ByFre W., Billmeyer
7. Engineering ChemistryBy Satya Prakash

ENGINEERING CHEMISTRY- PRACTICAL

BTME106P

Course Outcomes:

1. Use of different analytical instruments.
2. Measure molecular/system properties such as surface tension, viscosity, conductance of solution, chloride and iron content in water.
3. Measure hardness of water.
4. Estimate the rate constant of reaction.

List Of Experiments

1. Determination of alkalinity in the given water sample.
2. Determination of temporary and permanent hardness in water sample using EDTA.
3. Determination of iron content in the given solution by Mohr's method.
4. Determination of viscosity of given liquid.
5. Determination of surface tension of given liquid.
6. Determination of chloride content in water sample.
7. Determination of available chlorine in bleaching powder.
8. Determination of pH by pH-metric titration.
9. Preparation of Phenol-formaldehyde and Urea-formaldehyde resin.
10. Determination of Cell constant and conductance of a solution.
11. Determination of rate constant of hydrolysis of esters.
12. Verification of Beer's law.

NOTE: Choice of any 8 experiments from the above.

ENGINEERING MATHEMATICS-I

BTME104

Course Outcomes

1. Remember the concept of matrices and apply for solving linear simultaneous equations.
2. Understand the concept of limit, continuity and differentiability and apply in the study of Rolle,s , Lagrange,s and Cauchy mean value theorem and Leibnitz theorems .
3. Identify the application of partial differentiation and apply for evaluating maxima, minima, series and Jacobians.
4. Illustrate the working methods of multiple integral and apply for finding area, volume, centre of mass and centre of gravity.
5. Remember the concept of vector and apply for directional derivatives, tangent and normal planes. Also evaluate line, surface and volume integrals.

Module 1: Matrices [08]

Types of Matrices: Symmetric, Skew-symmetric and Orthogonal Matrices; Complex Matrices, Inverse and Rank of matrix using elementary transformations, Rank-Nullity theorem; System of linear equations, Characteristic equation, Cayley-Hamilton Theorem and its application, Eigen values and eigenvectors; Diagonalisation of a Matrix.

Module 2: Differential Calculus- I [08]

Introduction to limits, continuity and differentiability, Rolle's Theorem, Lagrange's Mean value theorem and Cauchy mean value theorem, Successive Differentiation (n^{th} order derivatives), Leibnitz theorem and its application, Envelope, Involutes and Evolutes, Curve tracing: Cartesian and Polar co-ordinates.

Module 3: Differential Calculus-II [08]

Partial derivatives, Total derivative, Euler's Theorem for homogeneous functions, Taylor and Maclaurin's theorems for a function of one and two variables, Maxima and Minima of functions of several variables, Lagrange Method of Multipliers, Jacobians, Approximation of errors.

Module 4: Multivariable Calculus-I [08]

Multiple integration: Double integral, Triple integral, Change of order of integration, Change of variables, **Application:** Areas and volumes, Center of mass and center of gravity (Constant and variable densities).

Module 5: Vector Calculus [08]

Vector differentiation: Gradient, Curl and Divergence and their Physical interpretation, Directional derivatives, Tangent and Normal planes.

Vector Integration: Line integral, Surface integral, Volume integral, Gauss's Divergence theorem, Green's theorem, Stoke's theorem (without proof) and their applications.

Text Books:-

1. B. V. Ramana, Higher Engineering Mathematics, Tata Mc Graw-Hill Publishing Company Ltd., 2008.
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.

3. R K. Jain & S R K. Iyenger , Advance Engineering Mathematics, Narosa Publishing House 2002.

Reference Books-

1. E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.
2. Peter V. O'Neil, Advance Engineering Mathematics, Thomson (Cengage) Learning, 2007.
3. Maurice D. Weir, Joel Hass, Frank R. Giordano, Thomas, Calculus, Eleventh Edition, Pearson.
4. D. Poole, Linear Algebra : A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
5. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
6. Ray Wylie C and Louis C Barret, Advanced Engineering Mathematics, Tata Mc-Graw-Hill; Sixth Edition.
7. P. Sivaramakrishna Das and C. Vijayakumari, Engineering Mathematics, 1st Edition, Pearson India Education Services Pvt. Ltd
8. Advanced Engineering Mathematics. Chandrika Prasad, Reena Garg, 2018.
9. Engineering Mathemathics – I. Reena Garg, 2018.

ENGLISH

BTME105

Course Outcomes

1. Students will be enabled to understand the basic objective of the course by being acquainted with specific dimensions of communication skills i.e. Reading, Writing, Listening, Thinking and Speaking.
2. Students would be able to create substantial base by the formation of strong professional vocabulary for its application at different platforms and through numerous modes as Comprehension, reading, writing and speaking etc.
3. Students will apply it at their work place for writing purposes such as Presentation/official drafting / administrative communication and use it for document/project/report/research paper writing.
4. Students will be made to evaluate the correct & error-free writing by being well-versed in rules of English grammar & cultivate relevant technical style of communication & presentation at their work place & also for academic uses.
5. Students will apply it for practical and oral presentation purposes by being honed up in presentation skills and voice-dynamics. They will apply techniques for developing inter-personal communication skills and positive attitude leading to their professional competence.

Module 1- Basics of Technical English [08]

Technical English: Definition; Extent& Coverage; Dimensions; Reading; Skimming: Scanning Churning & Assimilation; Writing: Methods: Inductive; Deductive; Exposition; Linear; Interrupted; Spatial & Chronological etc; Technical Communication; Approaches: Brevity; Objectivity; Simplicity; Utility & Clarity. **Listening**: Active; Passive; Thinking strategies: Positive & Logical thinking; Speaking: Essentials Nuances & Modes of Speech Delivery.

Module 2- Components of Technical Writing [08]

Vocabulary Building: Select words; Concept of word formation; Word formation; Root words from foreign languages & their use in English; Prefixes & Suffixes: Derivatives; Synonyms; Antonyms; Abbreviations. Homophones. One word substitutes; Requisites of Sentences.

Module 3- Basic Technical Writing Skills [08]

Forms: Business writing: Principle; Purchase & Sales Letters; Drafts; Official Writing: Official Letter; D.O. Letter; Notices; Agenda; Minutes of Meeting; Sentence Structure; Phrases & Clauses in sentences; Coherence; Unity; Emphasis in Writing; Devices; Use of Writing methods in Documents; Techniques of writing.

Module 4- Common Grammatical Errors & Technical Style [08]

Subject-verb agreement; Correct usage: Noun; Pronoun; Agreement; Modifiers; Articles; Prepositions; Cliches; Redundancies; Technical Style: Features; Choice of words; Sentences: Descriptive; Narrative; Expository; Defining & Classifying; Length of paragraph; Writing of Introduction & Conclusion.

Module 5- Presentation Strategies & Oral Communications [08]

Analysis of locale; Audience; Modulating Style & Content; Speaking with confidence; Kinesics; Paralinguistic features of Voice-Dynamics: Pitch; Intonation; Stress & Rhythm; Conversation & dialogues; Communication at work-place; etc.

Text Books:

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi.

Reference Books:

1. Word Power Made Easy by Norman Lewis, W.R.Goyal Pub. & Distributors, 2009, Delhi.
2. Manual of Practical Communication by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2013, Delhi.
3. English Grammar and Usage by R.P.Sinha, Oxford University Press, 2005, New Delhi.
4. English Grammar, Composition and Usage by N.K.Agrawal&F.T.Wood, Macmillan India Ltd., New Delhi.
5. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House
6. English Grammar & Composition by Wren & Martin, S.Chand& Co. Ltd., New Delhi.
7. Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt. Ltd, 2011, New Delhi.
8. Personality Development, Harold R. Wallace &L.Ann Masters, Cengage Learning, New Delhi
9. Personality Development & Soft Skills, BarunK.Mitra, Oxford University Press, 2012 New Delhi.
10. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
11. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.
12. Spoken English- A manual of Speech and Phonetics by R.K.Bansal&J.B.Harrison, Orient Blackswan, 2013, New Delhi.
13. Business English by Ken Taylor, Orient Blackswan, 2011, New Delhi.

MECHANICAL WORKSHOP LAB

BTME109P

Course Outcomes

- **a.** Use various engineering materials, tools, machines and measuring equipments.
- **b.** Perform machine operations in lathe and CNC machine.
- **c.** Perform manufacturing operations on components in fitting and carpentry shop.
- **d.** Perform operations in welding, moulding, casting and gas cutting.
- **e.** Fabricate a job by 3D printing manufacturing technique

S. No.	Mechanical Workshop	Duration
	Introduction to Mechanical workshop material, tools and machines	
1	To study layout, safety measures and different engineering materials (mild steel, medium carbon steel, high carbon steel, high speed steel and cast iron etc) used in workshop. To study and use of different types of tools, equipments, devices & machines used in fitting, sheet metal and welding section. To determine the least count of vernier caliper, vernier height gauge, micrometer (Screw gauge) and take different reading over given metallic pieces using these instruments.	**3 Hours**
	Machine shop	
2	Demonstration of working, construction and accessories for Lathe machine Perform operations on Lathe - Facing, Plane Turning, step turning, taper turning, threading, knurling and parting.	**3 Hours**
	Fitting shop	
3	1. Practice marking operations. **2.** Preparation of U or V -Shape Male Female Work piece which contains: Filing, Sawing, Drilling, Grinding.	**3 Hours**
	Carpentry Shop	
4	Study of Carpentry Tools, Equipment and different joints. Making of Cross Half lap joint, Half lap Dovetail joint and Mortise Tension Joint	**3 Hours**
	Welding Shop	
5	Introduction to BI standards and reading of welding drawings.	

SEMESTER II

Fundamental of Mechanical Engineering and Mechatronics
BTME201

Unit	Topics	Lectures
I	**Unit I: Introduction to Mechanics of Solid:** Normal and shear Stress, strain, Hookes' law, Poisson's ratio, elastic constants and their relationship, stress-strain diagram for ductile and brittle materials, factor of safety. Basic Numerical problems. Types of beams under various loads, Statically Determinate Beams, Shear force and bending moment in beams, Shear force and bending moment diagrams, Relationships between load, shear and bending moment. Basic Numerical problems.	8
II	**Introduction to IC Engines and RAC:** **IC Engine:** Basic Components, Construction and Working of Two stroke and four stroke SI & CI engine, merits and demerits, scavenging process; Introduction to electric, and hybrid electric vehicles. **Refrigeration:** Its meaning and application, unit of refrigeration; Coefficient of performance, methods of refrigeration, construction and working of domestic refrigerator, concept of heat pump. Formula based numerical problems on cooling load. **Air-Conditioning:** Its meaning and application, humidity, dry bulb, wet bulb, and dew point temperatures, comfort conditions, construction and working of window air conditioner.	10
III	**Introduction to Fluid Mechanics and Applications:** **Introduction:** Introduction: Fluids properties, pressure, density, dynamic and kinematic viscosity, specific gravity, Newtonian and Non-Newtonian fluid, Pascal's Law, Continuity Equation, Bernaulli's Equation and its applications, Basic Numerical problems. Working principles of hydraulic turbines & pumps and their classifications, hydraulic accumulators, hydraulic lift and their applications.	7
IV	**Measurements and Control System:** Concept of Measurement, Error in measurements, Calibration, measurements of pressure, temperature, mass flow rate, strain, force and torques; Concept of accuracy, precision and resolution, Basic Numerical problems. System of Geometric Limit, Fit, Tolerance and gauges, Basic Numerical problems.	8
V	**Control System Concepts:** Introduction to Control Systems, Elements of control system, Basic of open and closed loop control with example. **Introduction to Mechatronics:** Evolution, Scope, Advantages and disadvantages of Mechatronics, Industrial applications of Mechatronics,	10

Introduction to autotronics, bionics, and avionics and their applications. Sensors and Transducers: Types of sensors, types of transducers and their characteristics.

Overview of Mechanical Actuation System – Kinematic Chains, Cam, Train Ratchet Mechanism, Gears and its type, Belt, Bearing.

Hydraulic and Pneumatic Actuation Systems: Overview: Pressure Control Valves, Cylinders, Direction Control Valves, Rotary Actuators, Accumulators, Amplifiers, and Pneumatic Sequencing Problems.

Reference Books:

1 Basic Mechanical Engineering, G Shanmugam, S Ravindran, McGraw Hill
2 Basic Mechanical Engineering, M P Poonia and S C Sharma, Khanna Publishers
3 Mechatronics : Principles, Concepts and Applications, Nitaigour Mahalik, McGraw Hill
4 Mechatronics, As per AICTE: Integrated Mechanical Electronic Systems, K.P. Ramachandran, G.K. Vijayaraghavan, M.S.Balasundaram, Wiley India
5 Mechanical Measurements & Control, Dr. D. S. Kumar. Metropolitan Book Company
6 Fluid Mechanics and Hydraulic Machines, Mahesh Kumar, Pearson India

Basic Electrical Engineering
BTME202

Course Outcomes

1. Apply the concepts of KVL/KCL and network theorems in solving DC circuits.
2. Analyze the steady state behavior of single phase and three phase AC electrical circuits.
3. Identify the application areas of a single phase two winding transformer as well as an auto transformer and calculate their efficiency. Also identify the connections of a three phase transformer.
4. Illustrate the working principles of induction motor, synchronous machine as well as DC machine and employ them in different area of applications.
5. Describe the components of low voltage electrical installations and perform elementary calculations for energy consumption.

Module - 1: DC Circuits [08]

Electrical circuit elements (R, L and C), Concept of active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, Kirchhoff's laws, Loop and nodal methods of analysis, Star-delta transformation, Superposition theorem, Thevenin theorem, Norton theorem.

Module - 2: Steady- State Analysis of Single Phase AC Circuits [08]

Representation of Sinusoidal waveforms – Average and effective values, Form and peak factors, Concept of phasors, phasor representation of sinusoidally varying voltage and current. Analysis of single phase AC Circuits consisting of R, L, C, RL, RC, RLC combinations (Series and Parallel), Apparent, active & reactive power, Power factor, power factor improvement. Concept of Resonance in series & parallel circuits, bandwidth and quality factor. Three phase balanced circuits, voltage and current relations in star and delta connections.

Module - 3 : Transformers [08]

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Module –4 : Electrical machines [08]

DC machines: Principle & Construction, Types, EMF equation of generator and torque equation of motor, applications of DC motors (simple numerical problems)

Three Phase Induction Motor: Principle & Construction, Types, Slip-torque characteristics, Applications (Numerical problems related to slip only)

Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications.

Three Phase Synchronous Machines: Principle of operation of alternator and synchronous motor and their applications.

Module –5 : Electrical Installations [06]

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Importance of earthing. Types of Batteries, Important characteristics for Batteries.Elementary calculations for energy consumption and savings, battery backup.

Spoken Tutorial (MOOCs):

1. AC DC Circuit Analysis using NgSpice, Open Source Software (http://spoken-tutorial.org)

Text Books:

1. Ritu Sahdev, “Basic Electrical Engineering”, Khanna Publishing House.
2. S. Singh, P.V. Prasad, “Electrical Engineering: Concepts and Applications” Cengage.
3. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill.
4. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill.

Reference Books:

1. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
2. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press.
3. V. D. Toro, “Electrical Engineering Fundamentals”, Pearson India.

Basic Electrical Engineering-Lab
BTME207P

Course Outcomes

1. Conduct experiments illustrating the application of KVL/KCL and network theorems to DC electrical circuits.
2. Demonstrate the behavior of AC circuits connected to single phase AC supply and measure power in single phase as well as three phase electrical circuits.
3. Perform experiment illustrating BH curve of magnetic materials.
4. Calculate efficiency of a single phase transformer and DC machine.
5. Perform experiments on speed measurement and reversal of direction of three phase induction motor and Identify the type of DC and AC machines based on their construction.

List Of Experiments

Note: A minimum of 8 experiments from the following should be performed.

1. Verification of Kirchhoff's laws
2. Verification of Superposition and Thevenin Theorem.
3. Measurement of power and power factor in a single-phase ac series inductive circuit and study improvement of power factor using capacitor
4. Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.
5. Connection and measurement of power consumption of a fluorescent lamp (tube light).
6. Measurement of power in 3- phase circuit by two wattmeter method and determination of its power factor for star as well as delta connected load.
7. Determination of parameters of ac single phase series RLC circuit
8. To observe the B-H loop of a ferromagnetic material in CRO.
9. Determination of (i) Voltage ratio (ii) polarity and (iii) efficiency by load test of a single phase transformer.
10. Determination of efficiency of a dc shunt motor by load test
11. To study running and speed reversal of a three-phase induction motor and record speed in both directions.
12. Demonstration of cut-out sections of machines: dc machine, three phase induction machine, single-phase induction machine and synchronous machine.

Engineering Physics
BTME203

Course Outcomes:

1. To solve the classical and wave mechanics problems
2. To develop the understanding of laws of thermodynamics and their application in various processes
3. To formulate and solve the engineering problems on Electromagnetism & Electromagnetic Field Theory
4. To aware of limits of classical physics & to apply the ideas in solving the problems in their parent streams

Module - 1 Relativistic Mechanics: [8]

Frame of reference, Inertial & non-inertial frames, Galilean transformations, Michelson- Morley experiment, Postulates of special theory of relativity, Lorentz transformations, Length contraction, Time dilation, Velocity addition theorem, Variation of mass with velocity, Einstein˝s mass energy relation, Relativistic relation between energy and momentum, Massless particle.

Module- 2 Electromagnetic Field Theory: [8]

Continuity equation for current density, Displacement current, Modifying equation for the curl of magnetic field to satisfy continuity equation, Maxwell˝s equations in vacuum and in non conducting medium, Energy in an electromagnetic field, Poynting vector and Poynting theorem, Plane electromagnetic waves in vacuum and their transverse nature. Relation between electric and magnetic fields of an electromagnetic wave, Energy and momentum carried by electromagnetic waves, Resultant pressure, Skin depth.

Module- 3 Quantum Mechanics: [8]

Black body radiation, Stefan˝s law, Wien˝s law, Rayleigh-Jeans law and Planck˝s law, Wave particle duality, Matter waves, Time-dependent and time-independent Schrodinger wave equation, Born interpretation of wave function, Solution to stationary state Schrodinger wave equation for one-Dimensional particle in a box, Compton effect.

Module- 4 Wave Optics: [10]

Coherent sources, Interference in uniform and wedge shaped thin films, Necessity of extended sources, Newton˝s Rings and its applications. Fraunhoffer diffraction at single slit and at double slit, absent spectra, Diffraction grating, Spectra with grating, Dispersive power, Resolving power of grating, Rayleigh˝s criterion of resolution, Resolving power of grating.

Module- 5Fibre Optics & Laser: [10]

Fibre Optics**:** Introduction to fibre optics, Acceptance angle, Numerical aperture, Normalized frequency, Classification of fibre, Attenuation and Dispersion in optical fibres. Laser: Absorption of radiation, Spontaneous and stimulated emission of radiation, Einstein˝s coefficients, Population inversion, Various levels of Laser, Ruby Laser, He-Ne Laser, Laser applications.

Reference Books:

1. Concepts of Modern Physics - AurthurBeiser (Mc-Graw Hill)
2. Introduction to Special Theory of Relativity- Robert Resnick (Wiley)
3. Optics - Brijlal& Subramanian (S. Chand)
4. Engineering Physics: Theory and Practical- Katiyar and Pandey (Wiley India)

5. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New)
6. Engineering Physics-Malik HK and Singh AK (McGrawHill)

Engineering Physics Lab
BTME206P

List of Experiments

Any ten experiments

1. To determine the wavelength of sodium light by Newton‟s ring experiment.

2. To determine the wavelength of different spectral lines of mercury light using plane transmission grating.

2. To measure attenuation in an optical fiber.
3. To determine the wavelength of He-Ne laser light using single slit diffraction.
4. To determine the wavelength of sodium light with the help of Fresnel‟s bi-prism.
5. To determine the coefficient of viscosity of a given liquid.

6. To determine the value of acceleration due to gravity (g) using compound pendulum.
8. To determine the energy band gap of a given semiconductor material.

9. To study Hall effect and determine Hall coefficient, carrier density and mobility of a given semiconductor material using Hall effect setup.

10. To determine the variation of magnetic field with the distance along the axis of a current carrying coil and estimate the radius of the coil.

11. To study the resonance condition of a series LCR circuit.

12. To draw hysteresis (B-H curve) of a specimen in the form of a transformer and to determine its hysteresis loss.

Reference Books

1. Practical Physics- K. K. Dey & B. N. Dutta (Kalyani Publishers New Delhi)
2. Engineering Physics-Theory and Practical- Katiyar& Pandey (Wiley India)
3. Engineering Physics Practical- S K Gupta (KrishnaPrakashan Meerut)

Course Outcomes:

4. To determine the wavelength of sodium light by Newton‟s ring experiment
1. To determine the wavelength of sodium light with the help of Fresnel‟s bi-prism

2. To determine the variation of magnetic field with the distance along the axis of a current carrying coil and estimate the radius of the coil.

To draw hysteresis (B-H curve) of a specimen in the form of a transformer and to determine its hysteresis loss.

Engineering Mathematics-II
BTME204

Course Outcomes

1. Understand the concept of differentiation and apply for solving differential equations.
2. Remember the concept of definite integral and apply for evaluating surface areas and volumes.
3. Understand the concept of convergence of sequence and series. Also evaluate Fourier series
4. Illustrate the working methods of complex functions and apply for finding analytic functions.
5. Apply the complex functions for finding Taylor's series, Laurent's series and evaluation of definite integrals

Module 1: Ordinary Differential Equation of Higher Order **[10]** Linear differential equation of n^{th} order with constant coefficients, Simultaneous linear differential equations, Second order linear differential equations with variable coefficients, Solution by changing independent variable, Reduction of order, Normal form, Method of variation of parameters, Cauchy-Euler equation, Series solutions (Frobenius Method).

Module 2: Multivariable Calculus-II **[08]**
Improper integrals, Beta & Gama function and their properties, Dirichlet's integral and its applications, Application of definite integrals to evaluate surface areas and volume of revolutions.

Module 3: Sequences and Series **[08]**
Definition of Sequence and series with examples, Convergence of sequence and series, Tests for convergence of series, (Ratio test, D' Alembert's test, Raabe's test). Fourier series, Half range Fourier sine and cosine series.

Module 4: Complex Variable – Differentiation **[08]**
Limit, Continuity and differentiability, Functions of complex variable, Analytic functions, Cauchy- Riemann equations (Cartesian and Polar form), Harmonic function, Method to find Analytic functions, Conformal mapping, Mobius transformation and their properties

Module -5 Complex Variables – Integration **[08]**
Complex integrals, Contour integrals, Cauchy- Goursat theorem, Cauchy integral formula, Taylor's series, Laurent's series, Liouvilles's theorem, Singularities, Classification of Singularities, zeros of analytic functions, Residues, Methods of finding residues, Cauchy Residue theorem, Evaluation of real integral of the type $\int_0^{2\pi} f(cos\theta, \sin\theta)d\theta$ and $\int_{-\infty}^{\infty} f(x)dx$.

Text Books:-

1. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill Publishing Company Ltd., 2008.
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.
3. R. K. Jain & S. R. K. Iyenger , Advance Engineering Mathematics , Narosa Publishing -House, 2002.

Reference Books:-

1. E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.
2. Peter V. O'Neil, Advance Engineering Mathematics, Thomson (Cengage) Learning, 2007.
3. Maurice D. Weir, Joel Hass, Frank R.Giordano, Thomas, Calculus, Eleventh Edition, Pearson.
4. G.B Thomas, R L Finney, Calculus and Analytical Geometry, Ninth Edition Pearson, 2002.
5. James Ward Brown and Ruel V Churchill, Fourier Series and Boundary Value Problems, 8th Edition-Tata McGraw-Hill
6. D. Poole , Linear Algebra : A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
7. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
8. Charles E Roberts Jr, Ordinary Diffrential Equations, Application, Model and Computing, CRC Press T&F Group.
9. Ray Wylie C and Louis C Barret, Advanced Engineering Mathematics, 6th Edition, Tata McGraw-Hill.
10. James Ward Brown and Ruel V Churchill, Complex Variable and Applications, 8th Edition, Tata McGraw-Hill.
11. P. Sivaramakrishna Das and C. Vijayakumari, Engineering Mathematics, 1st Edition, Pearson India Education Services Pvt. Ltd.
12. Advanced Engineering Mathematics By Chandrika Prasad, Reena Garg Khanna Publishing House, Delhi

Artificial Intelligence for Engineers

(BTME205)

Course Outcomes

1. Understand the evolution and various approaches of AI
2. Understand data storage, processing, visualization, and its use in regression, clustering etc.
3. Understand natural language processing and chatbots
4. Understand the concepts of neural networks.
5. Understand the concepts of face, object, speech recognition and robots.

Course	Topics
Unit 1	**An overview to AI**
1.1	The evolution of AI to the present
1.2	Various approaches to AI
1.3	What should all engineers know about AI?
1.4	Other emerging technologies
1.5	AI and ethical concerns
Unit 2	**Data & Algorithms**
2.1	History Of Data
2.2	Data Storage And Importance of Data and its Acquisition
2.3	The Stages of data processing
2.4	Data Visualization
2.5	Regression, Prediction & Classification
2.6	Clustering & Recommender Systems
Unit 3	**Natural Language Processing**
3.1	Speech recognition
3.2	Natural language understanding
3.3	Natural language generation
3.4	Chatbots
3.5	Machine Translation

Unit 4	**Artificial Neural Networks**
4.1	Deep Learning
4.2	Recurrent Neural Networks
4.3	Convolutional Neural Networks
4.4	The Universal Approximation Theorem
4.5	Generative Adversarial Networks
Unit 5	**Applications**
5.1	Image and face recognition
5.2	Object recognition
5.3	Speech Recognition besides Computer Vision
5.4	Robots
5.5	Applications

Reference Books:

1. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig, Prentice Hall
2. Artificial Intelligence by Kevin Knight, Elaine Rich, Shivashankar B. Nair, Publisher : McGraw Hill
3. Data Mining: Concepts and Techniques by Jiawei Han, Micheline Kamber, Jian Pei, Publisher: Elsevier Science.
4. Speech & Language Processing by Dan Jurafsky, Publisher : Pearson Education
5. Neural Networks and Deep Learning A Textbook by Charu C. Aggarwal, Publisher: Springer International Publishing
6. Introduction to Artificial Intelligence By Rajendra Akerkar, Publisher : PHI Learning

English Language Lab
BTME208P

Course Objectives:

(i) To facilitate software based learning to provide the required English Language proficiency to students.

(ii) To acquaint students with specific dimensions of communication skills i.e. Reading, Writing, Listening, Thinking and Speaking.

(iii) To train students to use the correct and error-free writing by being well versed in rules of English grammar.

(iv) To cultivate relevant technical style of communication and presentation at their work place and also for academic uses.

(v) To enable students to apply it for practical and oral presentation purposes by being honed up in presentation skills and voice-dynamics.

SYLLABUS: PROFESSIONAL COMMUNICATION LAB SHALL HAVE TWO PARTS:
Interactive and Communicative Practical with emphasis on Oral Presentation/Spoken Communication based on International Phonetic Alphabets (LP.A.)

List of Practicals

1. Group Discussion: Practical based on Accurate and Current Grammatical Patterns.
2. Conversational Skills for Interviews under suitable Professional Communication Lab conditions with emphasis on Kinesics.
3. Communication Skills for Seminars/Conferences/Workshops with emphasis on Paralinguistic /Kinesics.
4. Presentation Skills for Technical Paper/Project Reports/ Professional Reports based on proper Stress and Intonation Mechanics.
5. Official/Public Speaking based on suitable Rhythmic Patterns.
6. Theme Presentation/ Keynote Presentation based on correct methodologies argumentation.
7. Individual Speech Delivery/Conferencing with skills to defend Interjections/Quizzes.
8. Argumentative Skills/Role Play Presentation with Stress and Intonation.
9. Comprehension Skills based on Reading and Listening Practical's on a model Audio.

1. **Computer assisted software based Language Learning:** Software based self-guided learning to provide the required English language proficiency to students from an employability and career readiness standpoint. The software should align to Common European Framework of Reference for Languages (CEFR) and deliver a CEFR level – B2 upon completion.
2. **Interactive Communication Skills:** Students should practice the language with variety of activities and exercises based on employability skills as startup presentations, GD, Mock interview, Video portfolio, Extempore, Role play, Just A Minute (JAM) etc.

Suggested software:

1. **Oxford Achiever** by Oxford University Press.
2. **Cambridge English Empower** by Cambridge University Press.
3. **MePro.** by Pearson India Education Services Pvt. Ltd.

4. **New Interactions** by McGraw-Hill India.

Reference Books:

1. Word Power Made Easy by Norman Lewis, W.R. Goyal Pub. & Distributors, 2009, Delhi.
2. Manual of Practical Communication by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2013, Delhi.
3. A Course in Phonetics and Spoken English, Sethi & Dhamija:, Prentice Hall
4. English Pronouncing Dictionary, Joans Daniel, Cambridge University Press, 2007.
5. English Grammar and Usage by R. P. Sinha, Oxford University Press, 2005, New Delhi.
6. English Grammar, Composition and Usage by N.K. Agrawal & F.T. Wood, Macmillan India Ltd., New Delhi.
7. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House
8. English Grammar & Composition by Wren & Martin, S.Chand & Co. Ltd., New Delhi.
9. Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt. Ltd, 2011, New Delhi.
10. Personality Development, Harold R. Wallace & L. Ann Masters, Cengage Learning, New Delhi
11. Personality Development & Soft Skills, Barun K. Mitra, Oxford University Press, 2012 New Delhi.

Engineering Graphics and Design-Lab
(BTME209P)

Course Outcomes

1: Understanding of the visual aspects of engineering design
2: Understanding of engineering graphics standards and solid modelling
3: Effective communication through graphics
4: Applying modern engineering tools necessary for engineering practice
5: Appling computer-aided geometric design
6: Analysis of Isometric views
7: Creating working drawings

Module 1: Introduction to Engineering Drawing, Orthographic Projections [08]

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain and Diagonal Scales

Principles of Orthographic Projections – Conventions – Projections of Points and Lines inclined to both planes; Projections of planes inclined Planes – Auxiliary Planes.

Module 2: Projections and Sections of Regular Solids [08]

Sections in lined to both the Planes – Auxiliary Views; Simple annotation, dimensioning and scale. Floor plans the include: windows, doors and fixtures such as WC, Both, sink, shower, etc.

Prism, Cylinder, Pyramid, Cone – Auxiliary Vies: Development of surfaces of Right Regular Solids – Prism, Pyramid, Cylinder and Cone.

Module 3: Isometric Projections [08]

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conversions.

Module 4: Computer Graphics [08]

Listing the computer technologies the impact on graphical communication, Demonstration knowledge of the theory of CAD software [such as: The Menu System, Tollbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects: Isometric Views of lines, Planes, Simple and compound Solids];

Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles:

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to pater using the print command: orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modelling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-

dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, Multiview, auxiliary, and section views. Spatial visualization exercises Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling.

Module 5: Demonstration of a simple team design project [08]

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modelling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Suggested Text/ Reference Books:

(i) Bhatt N.D., Panchal V.M. & Ingle P.R. (2014), Engineering Drawing, Charotar Publishing House.
(ii) Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
(iii) Agrawal B. & Agrawal C.M. (2012), Engineering Graphics, TMH Publication
(iv) Engineering Graphics & Design, A.P. Gautam & Pradeep Jain, Khanna Publishing House
(v) Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
(Corresponding set of) CAD Software Theory and User Manuals

SEMESTER III

BTME301 –Mathematic s-III (PDE,ProbabilityandStatistics)

Course Outcomes

The objective of this course is to familiarize the students with partial differential equation, their application and statistical techniques. It aims to present the students with standard concepts and tools at an intermediate to superior level that will provide them well towards undertaking a variety of problems in the discipline.

The students will learn:

- The idea of partial differentiation and types of partial differential equations
- The idea of classification of second partial differential equations, wave , heat equation and transmission lines
- The basic ideas of statistics including measures of central tendency, correlation, regression and their properties.
- The idea s of probability and random variables and various discrete and continuous probability distributions and their properties.
- The statistical methods of studying data samples, hypothesis testing and statistical quality control, control charts and their properties.

Module I: Partial Differential Equations

Origin of Partial Differential Equations, Linear and Non Linear Partial Equations of first order, Lagrange's Equations, Charpit's method, Cauchy's method of Characteristics, Solution of Linear Partial Differential Equation of Higher order with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients.

Module II: Applications of Partial Differential Equations:

Classification of linear partial differential equation of second order, Method of separation of variables, Solution of wave and heat conduction equation up to two dimension, Laplace equation in two dimensions, Equations of Transmission lines.

Module III: Statistical Techniques I:

Introduction: Measures of central tendency, Moments, Moment generating function (MGF) , Skewness, Kurtosis, Curve Fitting , Method of least squares, Fitting of straight lines, Fitting of second degree parabola, Exponential curves ,Correlation and Rank correlation, Regression Analysis: Regression lines of y on x and x on y, regression coefficients, properties of regressions coefficients and non linear regression.

Module IV: Statistical Techniques II:

Probability and Distribution: Introduction, Addition and multiplication law of probability, Conditional probability, Baye's theorem, Random variables (Discrete and Continuous Random variable) Probability mass function and Probability density function, Expectation and variance, Discrete and Continuous Probability distribution: Binomial, Poission and Normal distributions.

Module V: Statistical Techniques III:

Sampling, Testing of Hypothesis and Statistical Quality Control: Introduction , Sampling Theory (Small and Large) , Hypothesis, Null hypothesis, Alternative hypothesis, Testing a Hypothesis, Level of significance, Confidence limits, Test of significance of difference of means, T-test, F-test and Chi-square test, One way Analysis of Variance (ANOVA).Statistical Quality Control (SQC) , Control Charts , Control Charts for variables ($\overline{X}$ and R Charts), Control Charts for Variables (p, np and C charts).

Text Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003(Reprint).
3. S. Ross: A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.

Reference Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
2.T.Veerarajan : Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi.
3. R.K. Jain and S.R.K. Iyenger: Advance Engineering Mathematics; Narosa Publishing House, New Delhi.
4. J.N. Kapur: Mathematical Statistics; S. Chand & Sons Company Limited, New Delhi.
5. D.N.Elhance,V. Elhance & B.M. Aggarwal: Fundamentals of Statistics; Kitab Mahal Distributers, New Delhi.

COURSEOUTCOMES

	Course Outcome (CO)	Bloom's Knowledge Level (KL)
	At the end of this course, the students will be able to:	
CO 1	Remember the concept of partial differential equation and to solve partial differential equations	K_1& K_3
CO 2	Analyze the concept of partial differential equations to evaluate the problems concerned with partial differential equations	K_4 & K_5
CO 3	Understand the concept of correlation, moments, skewness and kurtosis and curve fitting	K_2

CO 4	Remember the concept of probability to evaluate probability distributions	K_1 & K_5
CO 5	Apply the concept of hypothesis testing and statistical quality control to create control charts	K_3 & K_6

K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5 – Evaluate, K_6 – Create

Evaluation methodology to be followed:

The evaluation and assessment plan consists of the following components:

a. Class attendance and participation in class discussions etc. b. Quiz.
c. Tutorials and assignments. d. Sessional examination.
e. Final examination.

Award of Internal/External Marks:

Assessment procedure will be as follows:

1. These will be comprehensive examinations held on-campus (Sessionals).
2. Quiz.
   a. Quiz will be of type multiple choice, fill-in-the-blanks or match the columns. b. Quiz will be held periodically.
3. Tutorials and assignments
   a. The assignments/home-work may be of multiple choice type or comprehensive type at least one assignment from each Module/Unit.
   b. The grades and detailed solutions of assignments (of both types) will be accessible online after the submission deadline.
4. Final examinations.

Technical Communication
(BTME302)

Course Outcomes

1. Students will be enabled to **understand** the nature and objective of Technical Communication relevant for the work place as Engineers.
2. Students will utilize the technical writing for the purposes of Technical Communication and its exposure in various dimensions.
3. Students would imbibe inputs by presentation skills to enhance confidence in face of diverse audience.
4. Technical communication skills will **create** a vast know-how of the application of the learning to promote their technical competence.
5. It would enable them to **evaluate** their efficacy as fluent & efficient communicators by learning the voice-dynamics.

Unit -1 Fundamentals of Technical Communication:
Technical Communication: Features; Distinction between General and Technical Communication; Language as a tool of Communication
Dimensions of Communication: Reading & comprehension; Technical writing: sentences; Paragraph
Technical style: Definition, types & Methods; The flow of Communication: Downward; upward, Lateral or Horizontal; Barriers to Communication.

Unit - II Forms of Technical Communication:
Technical Report: Definition & importance;
Thesis/Project writing: structure & importance; synopsis writing: Methods
Technical research Paper writing: Methods & style; Seminar & Conference paper writing; **Key-Note Speech:** Introduction & Summarization; Expert Technical Lecture: Theme clarity; Analysis & Findings; 7 Cs of effective business writing: concreteness, completeness, clarity, conciseness, courtesy, correctness, consideration.

Unit - III Technical Presentation: Strategies & Techniques
Presentation: Forms; interpersonal Communication; Class room presentation; style; method;
Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation;
Overcoming Stage Fear: Confident speaking; Audience Analysis & retention of audience interest
Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.

Unit - IV Technical Communication Skills:
Interview skills, Group Discussion: Objective & Method; Seminar/Conferences Presentation
skills: Focus; Content; Style; Argumentation skills; Devices; Analysis; Cohesion & Emphasis; Critical thinking;
Nuances: Exposition narration & Description; effective business communication competence; Grammatical;
Discourse competence: combination of expression & conclusion;
Socio-linguistic competence: Strategic competence: Solution of communication problems with verbal and non verbal means.

Unit - V Kinesics & Voice Dynamics:

Kinesics: Definitions; importance; Features of Body Language; Voice Modulation: Quality, Pitch; Rhythm; intonation; Pronunciation; Articulation; stress & accent

Linguistic features of voice control: Vowel & Consonant Sounds.

Reference Books

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
2. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
3. Practical Communication: Process and Practice by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2014, Delhi.
4. Modern Technical Writing by Sherman, Theodore A (et.al); Apprentice Hall; New Jersey; U.S.
5. A Text Book of Scientific and Technical Writing by S.D. Sharma; Vikas Publication, Delhi.
6. Skills for Effective Business Communication by Michael Murphy, Harward University, U.S.
7. Business Communication for Managers by Payal Mehra, Pearson Publication, Delhi

Technical Communication Laboratory Practicals

Interactive and Communicative Practical with emphasis on Oral Presentation / Spoken Communication based on International Phonetic Alphabets (I.P.A.)

List of Practicals

1. Group Discussion: Practical based on Accurate and Current Grammatical Patterns.
2. Conversational Skills for Interviews under suitable Professional Communication Lab conditions with emphasis on Kinesics.
3. Communication Skills for Seminars/Conferences/Workshops with emphasis on Paralinguistics/Kinesics.
4. Presentation Skills for Technical Paper/Project Reports/ Professional Reports based on proper Stress and Intonation Mechanics.
5. Official/Public Speaking based on suitable Rhythmic Patterns.
6. Theme- Presentation/Key-Note Presentation based on correct argumentation methodologies.
7. Individual Speech Delivery/Conferencing with skills to defend Interjections/Quizzes.
8. Argumentative Skills/Role Play Presentation with Stress and Intonation.
9. Comprehension Skills based on Reading and Listening Practicals on a model Audio- Visual Usage.

Reference Books

1. Bansal R.K. & Harrison: A manual of Speech & Phonetics, Orient Black Swan Pvt. Ltd. New Delhi, 2010.
2. Sethi & Dhamija: A Course in Phonetics and Spoken English, Prentice Hall, New Delhi, 2011.

3. L.U.B.Pandey: Practical Communication-Process & Practice, A.I.T.B.S. Pub. India Ltd. Krishan Nagar, Delhi, 2013.
4. Joans Daniel, English Pronouncing Dictionary, Cambridge Univ. Press. 2007.

THERMODYNAMICS
(BTME303)

Objectives:

- To learn about work and heat interactions, and balance of energy between system andits surroundings.
- To learn about application of I law to various energy conversion devices.
- To evaluate the changes in properties of substances in various processes.
- To understand the difference between high grade and low-grade energies and II lawlimitations on energy conversion.

UNIT I

Review of Fundamental Concepts and Definitions: Introduction- Basic Concepts: System, ControlVolume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopicviewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle Reversibility Quasi – static Process, Irreversible Process, Causes of Irreversibility Energy and its forms, Work and heat (sign convention), Gas laws, Ideal gas, Real gas, Law of corresponding states, Property of mixture of gases, electrical, magnetic,gravitational, spring and shaft work. Zeroth law of thermodynamics:Concept of Temperature and its' measurement, Temperature scales.
First law of thermodynamics: First Law for Flow Processes - Derivation of general energy equation for a control volume;Steady state steady flow processes including throttling; Examples of steady flow devices;Unsteady processes; examples of steady and unsteady I law applications for system andcontrol volume. Limitations of first law of thermodynamics, PMM-I. Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc.

UNIT II

Second law of thermodynamics:
Thermal reservoirs, Energy conversion, Heat engines, Efficiency, Reversed heat engine, Heat pump, Refrigerator, Coefficient of Performance, Kelvin Planck and Clausius statement of second law of thermodynamics, Equivalence of the two statements. Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and it's corollaries, Thermodynamic Temperature Scale, PMM-II.
Entropy: Clausius inequality, Concept of Entropy, Entropy change of pure substance in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics.

UNIT III

Availability and Irreversibility: Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz & Gibb's function. Thermodynamic relations: Conditions for exact differentials. Maxwell relations, Clapeyron equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic and Isothermal compressibility.

UNIT IV

Properties of steam and Rankine cycle: Pure substance, Property of Pure Substance (steam), Triple point, Critical point, Saturation states, Sub- cooled liquid state, Superheated vapour state, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T, P-V and P-h diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables &Moller chart, Dryness factor and it's measurement, processes involving steam in closed and open systems. Simple Rankine cycle. Air-water vapour mixture and Psychrometry: Psychometric terms and their definitions, Psychometric chart, Different Psychometric processes and their representation on Psychometric chart.

UNIT V

Refrigeration Cycles: Reversed Carnot Cycle for gas and vapour. Refrigeration capacity, unit of refrigeration. Air Refrigeration cycles; Reversed Brayton Cycle and Bell Coleman Cycle. Vapour compression refrigeration cycle; simple saturated cycle and actual vapour compression refrigeration cycle. Analysis of cycles, effect of superheating, sub-cooling and change in evaporator and condenser pressure on performance of vapour compression refrigeration cycle. Refrigerants; their classification and desirable properties. Vapour absorption refrigeration system.

Course Outcomes:

- After completing this course, the students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions.
- Students can evaluate changes in thermodynamic properties of substances.
- The students will be able to evaluate the performance of energy conversion devices.
- The students will be able to differentiate between high grade and low-grade energies.

Books and References:

1. Basic and Applied Thermodynamics by PK Nag, MCGRAW HILL INDIA.
2. Thermodynamics for Engineers by Kroos& Potter, Cengage Learning.
3. Thermodynamics by Shavit and Gutfinger, CRC Press.
4. Thermodynamics- An Engineering Approach by Cengel, MCGRAW HILL INDIA.
5. Basic Engineering Thermodynamics, Joel, Pearson.
6. Fundamentals of Engineering Thermodynamics by Rathakrishnan, PHI.
7. Engineering Thermodynamics by Dhar, Elsevier.
8. Engineering Thermodynamics by Onkar Singh, New Age International.
9. Engineering Thermodynamics by CP Arora.
10. Engineering Thermodynamics by Rogers, Pearson.
11. Fundamentals of Engineering Thermodynamics by Moran, Shapiro, Boettner, & Bailey, John Wiley.
12. Engineering Thermodynamics by Mishra, Cengage Learning.
13. Refrigeration and Air Conditioning by C P Arora, MCGRAW HILL INDIA.

ENGINEERING MECHANICS

(BTME304)

To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

UNIT-I:

Two-dimensional force systems: Basic concepts, Laws of motion, Principle of transmissibility of forces, transfer of a force to parallel position, resultant of a force system, simplest resultant of two dimensional concurrent and non-concurrent force systems, distribution of force systems, free body diagrams, equilibrium and equations of equilibrium. Friction: Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction.

UNIT-II:

Beam: Introduction, shear force and bending moment, different equations of equilibrium, shear force and bending moment diagram for statically determined beams.

Trusses: Introduction, simple truss and solution of simple truss, methods of F-joint and methods of sections.

UNIT-III:

Centroid and moment of inertia: Centroid of plane, curve, area, volume and composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, principle moment of inertia, mass moment of inertia of circular ring, disc, cylinder, sphere, and cone about their axis of symmetry.

UNIT-IV:

Kinematics of rigid body: Introduction, plane motion of rigid body, velocity and acceleration under translational and rotational motion, relative velocity.

Kinetics of rigid body: Introduction, force, mass and acceleration, work and energy, impulse and momentum, D'Alembert's principle and dynamic equilibrium.

UNIT-V:

Simple stress and strain: Introduction, normal and shear stresses, stress-strain diagrams for ductile and brittle material, elastic constants, one-dimensional loading of members of varying cross sections, strain energy. Pure bending of beams: Introduction, simple bending theory, stress in beams of different cross sections.

Torsion: Introduction, torsion of shafts of circular cross sections, torque and twist, shear stress due to torque.

Course Outcomes:

After completing this course, the students should be able to understand the various effect of force and motion on the engineering design structures.

Books and References:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).

2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010).

3. A Textbook of Engineering Mechanics, R.K. Bansal, Laxmi Publications.

4. Engineering Mechanics, R.S. Khurmi, S.Chand Publishing.

5. Meriam J.L. and Kraige L.G., "Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons (1993).

6. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3 rd Edition, Vikas Publishing House Pvt. Ltd., (2005).

7. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, (1998).

8. Engineering mechanics by Irving H. Shames, Prentice-Hall.

Engineering Mechanics Lab

(BTME306P)

COURSE OBJECTIVES

To demonstrate students the basic principles of Engineering Mechanics, namely, Engineering Statics and Engineering Dynamics. The emphasis will be on pyschomotor skills.

List of Experiments:

1. To verify the Parallelogram law of forces.
2. To find the forces in the members of Jib Crane.
3. To verify the law of moments using Bell crank lever apparatus.
4. To determine the co-efficient of friction between wood and various surface (like Leather, Wood, Aluminum) on a Horizontal plane.
5. To determine the co-efficient of friction between wood and various surface (like Leather, Wood, Aluminum) on an inclined plane.
6. To find CG and Moment of Inertia of an irregular body using Computation method.
7. To find the axial force in the members of given Truss.
8. To determine the Mechanical Advantage, Velocity ratio and Mechanical efficiency of a Screw jack.
9. To determine the Mechanical advantage, Velocity ratio and Mechanical efficiency of the Wheel and Axle.
10. To determine the Mechanical advantage, Velocity ratio and Mechanical efficiency of the Worm and Worm Wheel.

COURSE OUTCOMES

1. Execute experiments and find out unknowns such as forces, moments, positions and velocities etc.
2. Calculate theoretical values of variables of concern and compare them with experimental values.

MATERIALS ENGINEERING (BTME305)

L-T-P
3-1-0

- Understanding of the correlation between the internal structure of materials, theirmechanical properties and various methods to quantify their mechanical integrity andfailure criteria.
- To provide a detailed interpretation of equilibrium phase diagrams.
- Learning about different phases and heat treatment methods to tailor the properties of Fe-Calloys.

UNIT-I

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids:Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slipsystems, critically resolved shear stress.

Mechanical Property measurement: Tensile, compression and torsion tests; Young'smodulus, relations between true and engineering stress-strain curves, generalized Hooke'slaw, yielding and yield strength, ductility, resilience, toughness and elastic recovery;Hardness: Rockwell, Brinell and Vickers and their relation to strength.

UNIT-II

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximumnormal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics:Introduction to Stress- intensity factor approach and Griffith criterion. Fatigue failure: Highcycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of meanstress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT).

UNIT-III

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binaryphase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstructural aspects ofledeburite, austenite, ferrite and cementite, cast iron.

UNIT-IV

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermaltransformation diagrams for Fe-C alloys and microstructure development. Continuouscooling curves and interpretation of final microstructures and properties- austempering,martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame andinduction hardening, vacuum and plasma hardening.

UNIT-V

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons;grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze andcupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titaniumalloys.

Course Outcomes:

- Student will be able to identify crystal structures for various materials and understand thedefects in such structures.
- Understand how to tailor material properties of ferrous and non-ferrous alloys.
- How to quantify mechanical integrity and failure in materials.

Books and References:

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
4. Mechanics of materials by James M.Gere.
5. Introduction to engineering materials by B.K. Agarwal.
6. Physical metallurgy and advanced materials by R.E. Smallman.
7. Engineering mechanics of composite materials by Isaac M. Daniel.
8. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

MATERIAL TESTING LAB (BTME307P)

L-T-P
0-0-2

Objectives:

- To understand the principles and performance characteristics different materials.
- To know about material roperties.

List of Experiments: (At least 8 of the following)

1. Strength test of a given mild steel specimen on UTM with full details and stress versus strain plot on the machine.
2. Other tests such as shear, bend tests on UTM.
3. Impact test on impact testing machine like Charpy, Izod or both.
4. Hardness test of given specimen using Rockwell and Vickers/Brinell testing machines.
5. Spring index test on spring testing machine.
6. Fatigue test on fatigue testing machine.
7. Creep test on creep testing machine.
8. Experiment on deflection of beam, comparison of actual measurement of deflection with dial gauge to the calculated one, and or evaluation of young's modulus of beam.
9. Torsion test of a rod using torsion testing machine.
10. Study of NDT (non-destructive testing) methods like magnetic flaw detector, ultrasonic flaw detector, eddy current testing machine, dye penetrant tests.

Course Outcomes:

The students who have undergone the course will be able to measure various properties of materials.

COMPUTER AIDED MACHINE DRAWING-I LAB (BTME308P)

L-T-P
0-0-2

Objectives:
To provide an overview of how computers can be utilized in mechanical component design.

UNIT-I
Introduction (1 drawing sheets)
Introduction, classification of machine drawings, principles of drawing, conventional representation of machine components and materials, lines, types of lines, dimensioning types, lines and rules of dimensioning.
Orthographic Projections (3 drawing sheets)
Introduction to orthographic projection, concept of first angle and third angle projection, drawing of simple machine elements in first angle projection, missing line problems, principle of visualization of objects, sectional views, full and half sectional views, auxiliary views.

UNIT-II
Fasteners (2 drawing sheets)
Temporary and permanent fasteners, thread nomenclature and forms, thread series, designation, representation of threads, bolted joints, locking arrangement of nuts, screws, washers, foundation bolts etc., keys, types of keys, cotter and knuckle joints.

UNIT-III
Riveted joints (1 drawing sheet)
Introduction, rivets and riveting, types of rivets, types of riveted joints, drawing of boiler joints etc.
Free hand sketching (1 drawing sheet)
Introduction, Need for free hand sketching, Free hand sketching of foundation bolts, studs, pulleys, couplings etc.

UNIT-IV
Assembly drawing (2 drawing sheets)
Introduction to assembly drawing, drawing assembly drawing of simple machine elements like rigid or flexible coupling, muff coupling, Plummer block, footstep bearing, bracket etc.

UNIT-V
Computer aided drafting (1 drawing)
Introduction to computer aided drafting; advantages and applications of CAD, concepts of computer aided 2D drafting using any drafting software like AutoCAD, Solid Edge, Draft Sight etc., basic draw and modify commands, making 2D drawings of simple machine parts.

Course Outcomes:
Upon completion of this course, the students can use computer and CAD software formodelling mechanical components.

Books and References:
1. Fundamentals of Machine Drawing by Sadhu Singh & Shah,
PHI.
2. Engineering Drawing by Bhat, & Panchal, Charotar Publishing House.
3. Machine Drawing with AutoCAD by Pohit and Ghosh,

Pearson.
4. Machine Drawing-KL Narayana, P Kannaiah, KV Reddy, New Age.
5. Machine Drawing, N. Siddeshswar, P Kannaiah, VVS Shastry, Tata McGraw Hill.
6. Engineering Drawing, Pathak,
Wiley.
7. Textbook of Machine Drawing, K C John,
PHI.
8. AutoCAD 2014 for Engineers & Designers, Bhatt, WILEY

Mini Project or Internship Assessment (BTME309P)

Semester -IV

Measurement and Metrology
[BTME401]

Unit-I

Mechanical Measurements: Introduction to measurement and measuring instruments. General concept–Generalized measurement system and its elements-Unit sand standards- measuring instruments: sensitivity, stability, range, accuracy and precision-static and dynamic response- repeatability-systematic, Source of error, statistical analysis of error and random errors- correction, calibration. Dimensional and geometric tolerance

Sensors and Transducers: Types of sensors, types of transducers and their characteristics.

Unit-II

Time Related Measurements: Stroboscope, frequency measurement by direct comparison. Measurement of displacement

Measurement of Pressure: Gravitational, directing acting, elastic and indirect type pressure transducers. Measurement of very low pressures (high vacuum).
Strain Measurement: Types of strain gauges and their working, strain gauge circuits, temperature compensation. Strain rosettes, calibration.

Unit-III

Flow Measurement: Hot Wire Anemometry, Laser Doppler Velocimetry, Rotameter

Temperature Measurement: Thermometers, bimetallic thermocouples, thermistors and pyrometers.

Measurements of Force, Torque: Different types of load cells, elastic transducers, pneumatic & hydraulic systems. Seismic instruments

Measurements of Acceleration, and Vibration: Accelerometers vibration pickups and decibel meters, vibrometers.

Unit-IV

Coordinate measuring machine (CMM): Need, constructional features and types,

Metrology and Inspection: Standards of linear measurement, line and end standards. Interchange ability and standardization. Linear and angular measurements devices and systems **Comparators:** Sigma, Johansson's Microkrator. Limit gauges classification, Taylor's Principle of Gauge Design.

Unit-V

Limits, Fits &Tolerance and Surface roughness: Introduction to Limits, Fits, Tolerances and IS standards, Limit-gauges, and surface-roughness. Measurement of geometric forms like

straightness, flatness, roundness. Tool makers microscope, profile projector, autocollimator. **Interferometry**: principle and use of interferometry, optical flat. Measurement of screw threads and gears. Surface texture: quantitative evaluation of surface roughness and its measurement.

Books and References:

1. Experimental Methods for Engineers by Holman, MCGRAW HILL INDIA
2. Mechanical Measurements by Beckwith, Pearson
3. Principles of Measurement Systems by Bentley, Pearson
4. Metrology of Measurements by Bewoor and Kulkarni, MCGRAW HILL INDIA
5. Measurement Systems, Application Design by Doeblein, MCGRAW HILL INDIA
6. Hume KJ, "Engineering Metrology", MacDonald and Co
7. Jain, RK, "Engineering Metrology" Khanna Publishers
8. Jain, R.K., "Mechanical Measurement" Khanna Publishers
9. Gupta SC, Engineering Metrology, Dhanpat Rai Publications

Measurement and Metrology-Lab
[BTME409P]

Minimum 8 experiments out of following (or such experiment) are to be performed:

1. Study the working of simple measuring instruments- Vernier calipers, micrometer, tachometer.
2. Measurement of effective diameter of a screw thread using 3 wire method.
3. Measurement of angle using sine bar & slip gauges. Study of limit gauges.
4. Study & angular measurement using level protector.
5. Adjustment of spark plug gap using feeler gauges.
6. Study of dial indicator & its constructional details.
7. Use of dial indicator to check a shape run use.
8. Use of dial indicator and V Block to check the circularity and plot the polar Graph.
9. Study and understanding of limits, fits & tolerances.
10. Experiment on measurement of pressure.
11. Study of temperature measuring equipments.
12. Measurement using Strain gauge.
13. Measurement of speed using stroboscope.
14. Experiment on measurement of flow.
15. Measurement of vibration/power.
16. Experiment on dynamometers.
17. To study the displacement using LVDT.

Universal Human Values and Professional Ethics
[BTME402]

Objectives:

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession.
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life

Course Outcome:

On completion of this course, the students will be able to

1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society.
2. Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.
3. Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society.
4. Understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.
5. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

UNIT-1

Course Introduction- Need, Basic Guidelines, Content and Process for Value Education Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT-2

Understanding Harmony in the Human Being- Harmony in Myself Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT-3

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship Understanding harmony in the Family- the basic unit of human interaction, Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)- from family to world family!.

UNIT-4

Understanding Harmony in the Nature and Existence- Whole existence so-existence Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature-

recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT-5

Implications of the above Holistic Understanding of Harmony on Professional Ethics Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.

Text Books:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.

References:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
5. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
6. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
7. A N Tripathy, 2003, Human Values, New Age International Publishers.
8. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
9. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press.
10. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Mode of Evaluation:

Assignment/ Seminar/Continuous Assessment Test/Semester End Exam

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.

APPLIED THERMODYNAMICS
(BTME403)

Objectives:

- To learn about of I law for reacting systems and heating value of fuels.
- To learn about gas and vapor cycles and their first law and second law efficiencies.
- To understand about the properties of dry and wet air and the principles of psychrometry.
- To learn about gas dynamics of air flow and steam through nozzles.
- To learn the about reciprocating compressors with and without intercooling.
- To analyze the performance of steam turbines.

UNIT I

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First lawanalysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flametemperature- Chemical equilibrium and equilibrium composition calculations using freeenergy. Introduction and Otto, Diesel and Dual cycles.

UNIT II

Vapour Power cycles:

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Rankine cycle, effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration. Fuels and Combustion: Combustion analysis, heating values, air requirement, Air/Fuel ratio, standard heat of reaction and effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature.

UNIT III

Boilers: Classifications and working of boilers, boiler mountings and accessories, Draught and its calculations, air pre-heater, feed water heater, super heater. Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance. Condenser: Classification of condenser, air leakage, condenser performance parameters.

UNIT IV

Steam and Gas Nozzles: Flow through Convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, choked flow, throat area, Nozzle efficiency, Off design operation of nozzle, Shock waves stationary normal shock waves, Effect of friction on nozzle, Super saturated flow. Steam Turbines: Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, state point locus, Losses in steam turbines, Governing of turbines, Comparison with steam engine.

UNIT V

Gas Turbine: Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles. Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines andtheir processes, Principle of rocket propulsion, Introduction to Rocket Engine.

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressureratio, effect of intercooling, minimum work for multistage reciprocating compressors.

Course Outcomes:

- After completing this course, the students will get a good understanding of various practical power cycles and heat pump cycles.
- They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors.
- They will be able to understand phenomena occurring in high speed compressible flows.

Books and References:

1. Basic and Applied Thermodynamics by P.K. Nag, mcgraw hill india.
2. Applied thermodynamics by Onkar Singh, New Age International.
3. Applied Thermodynamics for Engineering Technologists by Eastop, Pearson Education.
4. Applied Thermodynamics by Venkanna And Swati, PHI.
5. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
6. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India

7. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
8. Theory of Stream Turbine by WJ Kearton.

FLUID MECHANICS AND FLUID MACHINES
(BTME404)

L-T-P
3-1-0

Objectives:

- To learn about the application of mass and momentum conservation laws for fluid flows.
- To understand the importance of dimensional analysis.
- To obtain the velocity and pressure variations in various types of simple flows.
- To analyze the flow in water pumps and turbines.

UNIT-I

Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids,mass density, specific volume, specific gravity, viscosity, compressibility and surfacetension, Incompressible flow, Bernoulli's equation and its applications - Pitot tube, orifice meter, venturi meter and bend meter, notches and weirs, momentum equation and its application to pipe bends.

UNIT-II

Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and supercritical flows, one, two- and three- dimensional flows, streamlines, continuity equation for 3D and 1D flows, circulation, stream function and velocity potential. Buckingham's Pi theorem, important dimensionless numbers and their significance.

UNIT-III

Equation of motion for laminar flow through pipes, turbulent flow, isotropic, homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and pipe networks. Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sublayer, separation and its control, Drag and lift, drag on a sphere, a two-dimensional cylinder, and an aerofoil, Magnus effect.

UNIT-IV

Introduction to hydrodynamic thrust of jet on a fixed and moving surface, Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel. Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines.

UNIT-V

Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Cavitation & separation, Performance characteristics. Reciprocating pump theory, Slip, Indicator diagram, Effect of acceleration, air vessels, Comparison of centrifugal and reciprocating pumps, Performance characteristics.

Course Outcomes:

- Upon completion of this course, students will be able to mathematically analyze simple flow situations.
- They will be able to evaluate the performance of pumps and turbines.

Books and References:

1. Introduction to fluid mechanics and Fluid machines by S.K Som, Gautam Biswas, S Chakraborty.
2. Fluid mechanics and machines by R.K Bansal.
3. F. M. White, Fluid Mechanics, 6th Ed., Tata McGraw-Hill, 2008.
4. Fluid Mechanics and Its Applications byV.K.Gupta et.al.
5. Fluid Mechanics byYunusCengel.
6. Batchelor, G. K. (1999). Introduction to fluid dynamics. New Delhi, India: Cambridge University Press.
7. Acheson, D. J. (1990). Elementary fluid dynamics. New York, USA: Oxford UniversityPress.
8. R.W. Fox, A.T. McDonald and P.J. Pritchard, Introduction to Fluid Mechanics, 6th Ed., John Wiley, 2004.

FLUID MECHANICS LAB
(BTME408P)

L-T-P
0-0-2

- To understand the principles and performance characteristics of flow and thermal devices.
- To know about the measurement of the fluid properties.

List of Experiments:(At least 8 of the following)

1. To determine the coefficient of impact for vanes.
2. To determine coefficient of discharge of an orifice meter.
3. To determine the coefficient of discharge of Notch (V and Rectangular types).
4. To determine the friction factor for the pipes.
5. To determine the coefficient of discharge of venturi meter.
6. To determine the coefficient of discharge, contraction & velocity of an orifice.
7. To verify the Bernoulli's Theorem.
8. To find critical Reynolds number for a pipe flow.
9. To determine the meta-centric height of a floating body.
10. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
11. To show the velocity and pressure variation with radius in a forced vertex flow.

Course Outcomes:
The students who have undergone the course will be able to measure various properties offluids and characterize the performance of fluid/thermal machinery.

MANUFACTURING PROCESSES

(BTME405)

Objectives: L-T-P

3-1-0

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

UNIT-1

Conventional Manufacturing processes:

Casting and moulding: Metal casting processes and equipment, Heat transfer andsolidification,shrinkage, riser design, casting defects and residual stresses.Introduction to bulk and sheet metal forming, plastic deformation and yield criteria;fundamentals of hot and cold working processes; load estimation for bulk forming (forging,rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principlesof powder metallurgy.

UNIT-II

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components:Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, cutting tool materials, cutting fluids, Coating; Turning, Drilling, Milling and finishing processes,Introduction to CNC machining.Additive manufacturing: Rapid prototyping and rapid toolingJoining/fastening processes: Physics of welding, brazing and soldering;design considerationsin welding,Solid and liquid state joining processes;Adhesive bonding.

UNIT-III

Grinding & Super finishing:Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and cylindrical grinding. Centreless grinding.

Super finishing: Honing, lapping and polishing.

UNIT-IV

Metal Joining (Welding):Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding:Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing. Adhesive bonding. Weld decay in HAZ.

UNIT-V

Unconventional Machining Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, UltrasonicMachining, principles and process parameters. Electrical Discharge Machining, principle and processes parameters, MRR, surface finish,tool wear, dielectric, power and control circuits, wire EDM; Electro- chemical machining(ECM), etchant &maskant, process parameters, MRR and surface finish.Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron BeamMachining.

Course Outcomes:

Upon completion of this course, students will be able to understand the different conventionaland unconventional manufacturing methods employed for making different products.

Books and References:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
3. Manufacturing Technology by P.N. Rao., MCGRAW HILL INDIA.
4. Materials and Manufacturing by Paul Degarmo.
5. Manufacturing Processes by Kaushish, PHI.
6. Principles of Foundry Technology, Jain, MCGRAW HILL INDIA
7. Production Technology by RK Jain.
8. Degarmo, Black &Kohser, Materials and Processes in Manufacturing.

APPLIED THERMODYNAMICS LAB

(BTME406P)

L-T-P
0-0-2

Objectives:
To understand the principles and performance of various boilers and engines.

List of Experiments: (At least 8 of the following)

1. Study of Fire Tube boiler.
2. Study of Water Tube boiler.
3. Study and working of Two stroke petrol Engine.
4. Study and working of Four stroke petrol Engine.
5. Determination of Indicated H.P. of I.C. Engine by Morse Test.
6. Prepare the heat balance sheet for Diesel Engine test rig.
7. Prepare the heat balance sheet for Petrol Engine test rig.
8. Study and working of two stroke Diesel Engine.
9. Study and working of four stroke Diesel Engine.
10. Study of Velocity compounded steam turbine.
11. Study of Pressure compounded steam turbine.
12. Study of Impulse & Reaction turbine.
13. Study of steam Engine model.
14. Study of Gas Turbine Model.

Course Outcomes:
The student who have undergone the course will be able to identify various properties of system.

MANUFACTURING PROCESS LAB

(BTME 407P)

L-T-P
0-0-2

Objectives:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

List of Experiments: (At least 8 of the following along-with study of the machines/processes)

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine.
3. Tool grinding (to provide tool angles) on tool-grinder machine.
4. Gear cutting on milling machine.
5. Machining a block on shaper machine.
6. Finishing of a surface on surface-grinding machine.
7. Drilling holes on drilling machine and study of twist-drill.
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and its uses.
11. Gas welding experiment.
12. Arc welding experiment.
13. Resistance welding experiment.
14. Soldering & Brazing experiment.
15. Study and understanding of limits, fits & tolerances.
16. Study of temperature measuring equipment's.
17. Measurement using Strain gauge.
18. Experiment on dynamometers.
19. To study the displacement using LVDT.

Course Outcomes:

Upon completion of this course, students will be able to understand the different conventional and unconventional manufacturing methods employed for making different products.

Semester -V

Subject Code: BTME501	Heat and Mass Transfer	LTP:310	Credits: 4

The students will be able to		Blooms Taxonomy
CO-1	Understand the fundamentals of heat and mass transfer.	K2
CO-2	Apply the concept of steady and transient heat conduction.	K3
CO-3	Apply the concept of thermal behavior of fins.	K3
CO-4	Apply the concept of forced and free convection.	K3
CO-5	Apply the concept of radiation for black and non-black bodies.	K3
CO-6	Conduct thermal analysis of heat exchangers.	K4

UNIT-1

Introduction to Heat Transfer (L-5 Hours) Introduction of thermodynamics and Heat Transfer, Modes of Heat Transfer: Conduction, convection and radiation, Effect of temperature on thermal conductivity of different types of materials, Introduction to combined heat transfer mechanism, General differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems, Initial and system boundary conditions.

Steady State one-dimensional Heat conduction (L-3 Hours)

Simple and Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation, Concept of thermal resistance, Analogy between heat and electricity flow, Thermal contact resistance and over-all heat transfer coefficient, Critical radius of insulation for cylindrical, and spherical bodies.

UNIT-2

Fins (L-3 Hours)

Heat transfer through extended surfaces and its classification, Fins of uniform cross-sectional area, Error

in measurement of temperature of thermometer wells.

Transient Conduction (L-3 Hours)

Transient heat conduction, Lumped capacitance method, Time constant, Unsteady state heat conduction in one dimension only, Heisler charts and their applications.

UNIT-3

Forced Convection (L-5 Hours) Basic concepts: Hydrodynamic boundary layer, Thermal boundary layer, Approximate integral boundary layer analysis, Analogy between momentum and heat transfer in turbulent flow over a flat surface, Mixed boundary layer, Flow over a flat plate, Flow across a single cylinder and a sphere, Flow inside ducts, Thermal entrance region, Empirical heat transfer relations, Relation between fluid friction and heat transfer, Liquid metal heat transfer.

Natural Convection **(L-5 Hours)**

Physical mechanism of natural convection, Buoyant force, Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates, cylinders and sphere, combined free and forced convection, Effect of turbulence.

UNIT-4

Thermal Radiation (L-8 Hours) Basic concepts of radiation, Radiation properties of surfaces, Black body radiation Planck's law, Wein's displacement law, Stefan-Boltzmann law, Kirchhoff's law, Gray body, Shape factor, Black-body radiation, Radiation exchange between diffuse non-black bodies in an enclosure, Radiation shields, Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Greenhouse effect, Radiation network analysis.

UNIT-5

Heat Exchanger (L-5 Hours) Different types of heat exchangers, Fouling factors, Overall heat transfer coefficient, Logarithmic mean temperature difference (LMTD) method, Effectiveness-number of transfer unit (NTU) method and Compact Heat Exchangers.

Condensation and Boiling **(L-3 Hours)**

Introduction of condensation phenomena, Heat transfer relations for laminar film condensation on vertical surfaces and on outside& inside of a horizontal tube, Effect of non-condensable gases, Drop wise condensation, Heat pipes, Boiling modes, pool boiling, Hysteresis in boiling curve, Forced convection boiling.

Introduction to Mass Transfer **(L-2 Hours)**

Introduction of Fick's law of diffusion, Steady state equimolar counter diffusion, Steady state diffusion through a stagnant gas film, Heat and Mass Transfer Analogy -Convective Mass Transfer Correlations

Reference Books:-

1. Fundamentals of Heat and Mass Transfer, by Incroperra & DeWitt, John Wiley and Sons
2. Heat and Mass Transfer by Cengel, McGraw-Hill
3. Heat Transfer by J.P. Holman, McGraw-Hill
4. Heat and Mass Transfer by Rudramoorthy and Mayilsamy, Pearson Education
5. Heat Transfer by Ghoshdastidar, Oxford University Press
6. A text book on Heat Transfer, by Sukhatme, University Press.
7. Heat Transfer by Venkateshan, Ane Books Pvt Ltd
8. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill
9. Heat and Mass Transfer by R Yadav, Central Publishing House

Subject Code: BTME 502	Strength of Material	LTP:310	Credits: 4

Course Outcomes: The student will be able to		Blooms Taxonomy
CO 1	Understand the concept of stress and strain under different conditions of loading	K2
CO 2	Determine the principal stresses and strains in structural members	K3
CO 3	Determine the stresses and strains in the members subjected to axial, bending and torsional loads	K3
CO 4	Apply the concepts of stresses and strain in solving problems related to springs, column and pressure vessels	K3
CO 5	Calculate the slope, deflection and buckling of loaded members	K3
CO 6	Analyze the stresses developed in straight and curved beams of different cross sections	K4

Unit I **8 Hours**

Compound stress and strains: Introduction, normal stress and strain, shear stress and strain, stresses on inclines sections, strain energy, impact loads and stresses, state of plane stress, principal stress and strain, maximum shear stress, Mohr's circle for plane stress, three dimensional states of stress & strain, equilibrium equations, generalized Hook's law, theories of failure. Thermal Stresses.

Unit II **8 Hours**

Stresses in Beams: Pure Bending**,** normal stresses in beams, shear stresses in beams due to transverse and axial loads, composite beams.

Deflection of Beams: Differential equation of the elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method, fixed and continuous beams

Torsion: Torsion, combined bending & torsion of solid & hollow shafts, torsion of thin walled tubes.

Unit III **8 Hours**

Helical and Leaf Springs: Deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs.

Columns and Struts: Buckling and stability, slenderness ratio, combined bending and direct stress, middle third and middle quarter rules, struts with different end conditions, Euler's theory for pin ended columns, effect of end conditions on column buckling, Ranking Gordon formulae, examples of columns in mechanical equipment and machines.

Unit IV **8 Hours**

Thin cylinders & spheres: Introduction, difference between thin walled and thick walled pressure vessels, thin walled spheres and cylinders, hoop and axial stresses and strain, volumetric strain.

Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, compound cylinders, stresses in rotating shaft and cylinders, stresses due to interference fits.

Unit V **8 Hours**

Curved Beams: Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression.

Unsymmetrical Bending: Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section.

Text Books:

1. Strength of materials by Sadhu Singh, Khanna Book Publishing Co. (P) Ltd.
2. Strength of Material by Rattan, MC GRAW HILL INDIA
3. Mechanics of Materials by B.C. Punmia, Laxmi Publications (P) Ltd.

Reference Books:

1. Mechanics of Materials by Hibbeler, Pearson.
2. Mechanics of material by Gere, Cengage Learning
3. Mechanics of Materials by Beer, Jhonston, DEwolf and Mazurek, MC GRAW HILL INDIA
4. Strength of Materials by Pytel and Singer, Harper Collins
5. Strength of Materials by Ryder, Macmillan.
6. Strength of Materials by Timoshenko and Yσungs, East West Press.
7. Introduction to Solid Mechanics by Shames, Pearson
8. Mechanics of material by Pytel, Cengage Learning
9. An Introduction to Mechanics of Solids by Crandall, MC GRAW HILL INDIA
10. Strength of Materials by Jindal, Pearson Education
11. Strength of Materials by Basavajaiah and Mahadevappa, University Press.

Subject Code: BTME 503	Industrial Engineering	LTP:310	Credits: 4

Course Outcomes: The students will be able to		Blooms Taxonomy
CO1	Understand the concept of production system, productivity, facility and process planning in various industries	K2
CO2	Apply the various forecasting and project management techniques	K3
CO3	Apply the concept of break-even analysis, inventory control and resource utilization using queuing theory	K3
CO4	Apply principles of work study and ergonomics for design of work systems	K3
CO5	Formulate mathematical models for optimal solution of industrial problems using linear programming approach	**K4**

Unit-I:

Overview of Industrial Engineering: Types of production systems, concept of productivity, productivity measurement in manufacturing and service organizations, operations strategies, liability and process design.

Facility location and layout: Factors affecting facility location; principle of plant layout design, types of plant layout; computer aided layout design techniques; assembly line balancing; materials handling principles, types of material handling systems, methods of process planning, steps in process selection, production equipment and tooling selection, group technology, and flexible manufacturing.

Unit II:

Production Planning and control: Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality; aggregate production planning; master production scheduling; materials requirement planning (MRP) and MRP-II; routing, scheduling and priority dispatching, concept of JIT manufacturing system

Project Management: Project network analysis, CPM, PERT and Project crashing.

Unit III:

Engineering economy and Inventory control: Methods of depreciation; break-even analysis, techniques for evaluation of capital investments, financial statements, time-cost trade-off, resource levelling; Inventory functions, costs, classifications, deterministic inventory models, perpetual and periodic inventory control systems, ABC analysis, and VED analysis.

Queuing Theory: Basis of Queuing theory, elements of queuing theory, Operating characteristics of a queuing system, Classification of Queuing models.

Unit IV

Work System Design: Taylor's scientific management, Gilbreths's contributions; work study: method study, micro-motion study, principles of motion economy; work measurement –time study, work sampling, standard data,

Predetermined motion time system (PMTS); ergonomics; job evaluation, merit rating, incentive schemes, and wage administration.

Product Design and Development: Principles of product design, tolerance design; quality and cost considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, and concurrent engineering.

Unit V:

Operational Analysis: Formulation of LPP, Graphical solution of LPP, Simplex Method, Sensitivity Analysis, degeneracy and unbound solutions. transportation and assignment models; Optimality test: the stepping stone method and MODI method, simulation.

Books and References:

1. Industrial Engineering and Production Management by Martand T Telsang S. Chand Publishing
2. Industrial Engineering and Production Management by M. Mahajan Dhanpat Rai & Co. (P) Limited
3. Industrial Engineering and Management by Ravi Shankar, Galgotia Publications Pvt Ltd
4. Production and Operations Management by Adam, B.E. & Ebert, R.J., PHI
5. Product Design and Manufacturing by Chitale A.V. and Gupta R.C., PHI
6. Operations Research Theory & Applications by J K Sharma, Macmillan India Ltd,
7. Production Systems Analysis and Control by J.L.Riggs, John Wiley & Sons
8. Automation, Production Systems & Computer Integrated Manufacturing by Groover, M.P. PHI
9. Operations Research, by A.M. Natarajan, P. Balasubramani, A. Tamilarasi, Pearson Education
10. Operations Research by P. K. Gupta and D. S. Hira, S. Chand & Co.

Subject Code: BTME506P	Heat and Mass Transfer Lab	LTP:001	Credits: 1

The students will be able to		Blooms Taxonomy
CO1	Apply the concept of conductive heat transfer.	K3
CO2	Apply empirical correlations for both forced and free convection to determine the value of convection heat transfer coefficient	K3
CO3	Apply the concept of radiation heat transfer for black and grey body.	K3
CO4	Analyze the thermal behaviour of parallel or counter flow heat exchangers	K4
CO5	Conduct thermal analysis of a heat pipe	K4

List of Experiments

Minimum eight experiment of the following

1. To determine thermal conductivity of conductive material(s).
2. To determine thermal conductivity of insulating material(s).
3. To determine heat conduction through lagged pipe.
4. To determine heat transfer through fin under natural convection.
5. To determine the heat transfer Rate and Temperature Distribution for a Pin Fin.
6. Determination of thermal conductivity of different types of fluids.
7. Experiment on Stefan's Law - determination of emissivity, etc.
8. Experiment on convective heat transfer through flat plate solar collector.
9. To compare LMTD and Effectiveness of Parallel and Counter Flow Heat Exchangers.
10. To find the heat transfer coefficient for Forced Convection in a tube.
11. To find the heat transfer coefficient for Free Convection in a tube.
12. To conduct experiments on heat pipe.
13. To study the rates of heat transfer for different materials and geometries.
14. Visit to a Thermal Power Station for practical exposure.

COMPUTER AIDED MACHINE DRAWING-II LAB
(BTME507P)

L-T-P
0-0-2

Objectives:
To provide an overview of how computers can be utilized in mechanical component design.

Note: All drawing conforms to BIS Codes.

Introduction: Conventional representation of machine components and materials, Conventional representation of surface finish, Roughness number symbol, Symbols of Machine elements and welded joints. Classification of Drawings: Machine drawings, Production drawing, part drawing and assembly drawing. Introduction to detail drawing and bill of materials (BOM).

Limits, Fits and Tolerances: General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, Commonly used holes and shafts. List of Standard Abbreviation used.

Part Modelling: Introduction to part modelling of simple machine components using any 3D software (like CATIA, PRO E, UGNX, Autodesk Inventor or SOLIDWORKS) covering all commands/ features to develop a part model (Minimum 24 machine components need to be developed).

Part Modelling& Assemblies of: Plummer Block Bearing, Machine Vice, Screw Jack, Engine Stuffing box, Lathe Tailstock, Feed Check Valve and Rams Bottom Safety Valve.

Course Outcomes:
Upon completion of this course, the students can use computer and CAD software formodelling mechanical components.

Books and References:
1. Textbook of Machine Drawing, K C John, PHI.
2. Machine Drawing by K.R. Gopalakrishna, Subhas Stores.
3. A Textbook of Machine Drawing by PS Gill from S.K. Kataria& Sons.
4. Machine Drawing-KL Narayana, P Kannaiah, KV Reddy, New Age publications.
5. Engineering Graphics with AutoCAD, Bethune, PHI.
6. Machine Drawing, N. Siddeshswar, P Kannaiah, VVS Shastry, Tata McGraw Hill.
7. Fundamentals of Machine Drawing, Dr Sadhu Singh & P L Shah, Prantice Hall India.
8. Autodesk Inventor by Examples, Sam Tikoo, Wiley.

BTME508-P

Automobile Engineering. Lab

STUDIES TO BE CARRIED OUT (MINIMUM TEN EXPERIMENTS)

1. Study of Frame and Chassis.
2. Study of Clutches – Single Plate, Multi Plate and Centrifugal
3. Study of Gear Boxes – Sliding mesh, Constant mesh, Synchro mesh.
4. Study of Differential, Universal joints, Axles and Slip Joints.
5. Study of Brakes – Mechanical, Hydraulic, Air Brake and Disc Brake.
6. Study of Steering System used with Rigid Axle suspension and independent suspension system, Power Steering
7. Study of different types of springs used in Automobiles.
8. Study of Rigid Axle suspension system.
9. Study of Front Independent Suspension System.
10. Study of Read Independent Suspension System.
11. Study of Battery, Staring and Generating System and Battery Charging System.
12. Study of Automotive Electrical System.
13. Study of Educational Car Model.

LIST OF EQUIPMENTS/MACHINES REQUIRED

1. Working model of Single plate, Multi-plate & Centrifugal Clutch
2. Working model of Actual Differential System
3. Working model of Universal Joint, Axles & Slip Joints
4. Working model of Mechanical, Hydraulic and Air Brake
5. Working model of Steering System used with Rigid Axle suspension System
6. Working model of Steering System used with Independent Suspension System
7. Different types of Springs used in Automobiles
8. Working model of Rigid Axle Suspension System
9. Working model of Front Independent Suspension System
10. Working model of Rear Independent Suspension System
11. Working model of Battery, Staring and Generating System along with Charging unit
12. Working model of Electrical System
13. Cut section of Actual Master Cylinder of Hydraulic Brake System
14. Educational Car Model

Semester – V: Departmental Elective – I: Specialization – Manufacturing and Automation

Subject Code: BTME504A	Computer Integrated Manufacturing	LTP:300	Credits: 3

Course Outcome: Student will be able to		Bloom Taxonomy
CO 1	Understand the basic concepts of automation, computer numeric control machining	K2
CO 2	Understand the algorithms of line generation, circle generation, transformation, curve, surface modeling and solid modeling	K2
CO 3	Understand group technology, computer aided process planning, flexible manufacturing, Industry 4.0, robotics	K2
CO 4	Understand information system and material handling in CIM environment, rapid prototyping	K2
CO 5	Apply the algorithms of line & circle generation and geometric transformations	K3
CO6	Develop CNC program for simple operations	K3

Unit 1

Introduction to Computer Integrated Manufacturing (CIM): Introduction to CAD, CAM, CIM, Automated Manufacturing system; Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, Historical development and future trends. Computer Integrated Manufacturing, Computers in manufacturing industries.

Unit 2

Principles of Computer Graphics:

Point plotting, drawing of lines, Bresenham's circle algorithm.

Transformation in Graphics:

2D transformations – rotation, scaling, translation, mirror, reflection, shear – homogeneous transformations – concatenation, 3D transformations.

Curves: Introduction to Hermite cubic splines, Bezier curves, B-spline curves, NURBS

Surface Modeling: Polygon surfaces, Quadric surfaces, Superquadric surfaces and blobby objects

Solid modeling: Boolean set operations, Primitive instancing, Sweep representation, Boundadry representation, Constructive solid geometry,

Unit 3

Computer Aided Manufacturing:

NC in CAM – Principal types of CNC machine tools and their construction features – tooling for CNC – ISO designation for tooling – CNC operating system

Programming for CNC machining – coordinate systems – manual part programming – computer assisted part programming.

Unit 4

Group Technology: Group technology, Cellular Manufacturing, CAPP – Variant and Generative systems- Concurrent Engineering and Design for Manufacturing.

Flexible Manufacturing System: characteristics – economics and technological justification – planning, installation, operation and evaluation issues – role of group technology and JIT in FMS – typical case studies future prospects, Industry 4.0.

Robotics: Classification and specification – drive and controls – sensors - end effectors - grippers- tool handling and work handling – machine vision – robot programming concepts – case studies in assembly. Introduction to Programmable logical controller

Unit 5

Data and information in CIM: Management information system in CIM environment, MRP – MRP II – ERP

8. Capacity planning.

Material handling in CIM environment: Types – AGVS – AS/RS – Swarf handling and disposal of wastes – single and mixed mode assembly lines – quantitative analysis of assembly systems.

Rapid prototyping: Need for rapid prototyping, Basic principles and advantages of RP, General features and classifications of different RP techniques with examples.

Books and References:

1. Mikell P.Groover - Automation , Production Systems and Computer IntegratedManufacturing, Second edition, Prentice Hall of India.

2. Ibrahim Zeid - CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd.,Company Ltd., New Delhi.

3. Yoram Koren,Control of machine tools,McGraw-Hill.
4. Hearn & Baker, Computer Graphics, Prentice Hall of India
5. Sunil Kumar Srivastava, Computer Aided Design: A Basic and Mathematical Approach, I K International Publishing House
6. P.Radhakrishnan, - CAD/CAM/CIM, New Age International (P) Ltd., New Delhi

Semester – V: Departmental Elective – I: Specialization – Automation and Industry

Subject Code: BTME504B	Mechatronics Systems	LTP:300	Credits: 3

Course Outcome: Student will be able to		Bloom Taxonomy
CO 1	Identify key elements of mechatronics and its representation by block diagram.	K 2
CO 2	Understand the concept of sensors and use of interfacing systems.	K 2
CO 3	Understand the concept and applications of different actuators	K 2
CO 4	Illustrate various applications of mechatronic systems.	K 2
CO 5	Develop PLC ladder programming and implementation in real life problem.	K 5

Unit I: Mechatronics & Its Scope

Mechatronics System: Introduction to Mechatronic Systems, Evolution, Scope, Application Areas, Basic Elements and Control of Mechatronics systems, Advantages and disadvantages of Mechatronics, Industrial applications of Mechatronics, autotronics, bionics, and avionics and their applications

Control System Concepts: Introduction to Control Systems, Elements of control system, Basic of open and closed loop control with example.

Unit II: Sensor & Transducer

Definition and classification of sensor and transducer, performance terminology, static and dynamic characteristics, Principle of working and application of Inductive Proximity, Capacitive Proximity, Photoelectric, Ultrasonic, Magnetic, Hall Effect, Tactile Sensor, load cell, LVDT and interfacing sensors in Mechatronic system.

UNIT III: ACTUATION SYSTEMS

Fluid Based Actuation: Concept of Hydraulic and Pneumatic Actuation system, Oil and Air preparation unit, Direction Control Valve, Pressure Control Valve, Single and doubly actuated systems, Actuators and Accumulators.

Electrical Actuation Systems: Introduction to Switching devices,Concept of Electro Mechanical Actuation, Solenoids and Solenoid Operated Direction Control Valves, Principle of working of DC and 3 Phase Induction Motor, Stepper motors and Servo Motors with their merits and demerits.

UNIT IV: INDUSTRIAL CONTROLLERS

Programmable Logic Controllers: Basic Structure, Types and Working Principle, Concept of Scan Cycle and Scan Time, IO's and its Types, Selection Criteria and Applications

Programming Techniques: Ladder diagram –Concept of Contacts and Coil, Latching/ Holding Circuit, Memory Bits, Timers and Counter.

UNIT V: MECHATRONICS APPLICATIONS:

Control of conveyor motor, sorting and packaging unit, pick and place robot, coin counter, operations of bottling plant, domestic washing machine, use of PLC for extending and retracting pneumatic pistons and their different combinations, automatic car park system, engine management system, other applications in manufacturing.

Text Books:

5. Rolf Isennann, " Mechatronics Systems", Springer, 2005.
6. W. Bolten, "Mechatronics", Pearson Education 2003.
7. HMT Ltd, "Mechatronics:, Tata McGraw Hill 1998.
8. K. P. Ramachandran, G.K. Vijayaraghavan, M.S. Balasundaram, Mechatronics - Integrated Mechanical Electronic Systems, Wiley.

Semester – V: Departmental Elective – I: Specialization – Design and Analysis

Subject Code: BTME504C	Finite Element Methods	LTP:300	Credits: 3

Course Outcome: Student will be able to		Bloom Taxonomy
CO 1	Understand the basic concepts of FEM and its applications.	K2
CO 2	Apply the procedure involved to solve a problem using Finite Element Methods.	K3
CO 3	Develop the element stiffness matrices using different approach.	K3
CO 4	Analyze 1D and 2D problem using different methods.	K4
CO 5	Analyze the complex geometric problems through FEM software packages.	K4

Unit 1

Introduction, exact solution vs approximate solution, principle of FEM, application of FEM, general procedure for finite element analysis, pre-processing, solution, post processing, Stresses and Equilibrium; Boundary Conditions.

Unit 2

Strain-Displacement Relations, Stress–strain relations, Effect of temperature, various approximate methods: weighted residual method, variational or Rayleigh Ritz method, Galerkin's method, principle of minimum potential energy.

Unit 3

Basic element shapes, generalized co-ordinates, polynomials, natural co-ordinates in one-, two- and three-dimensions, Lagrange and Hermite polynomials, Application of Finite Element Methods to elasticity problems and heat conduction Problems.

Unit 4

One dimensional problem of finite element model, Coordinates and Shape function, Potential-energy approach, Galerkine approach, Assembly of Global Stiffness Matrix and Load Vector.

Plane trusses: Global and local coordinate system and stress calculation.

Beams and Frames: finite element formulation and calculation of Shear Force and Bending Moment.

Unit 5

Two-dimensional problem using Constant Strain Triangles and Four-node Quadrilateral, Problem modelling and Boundary conditions.

Practical consideration in finite element applications, problem solving on a general purpose FEM software package like ANSYS, ABAQUS, NISA etc.

Text Books:

1. Chandrupatla, T. R. and Belegundu, A. K., Introduction to Finite Elements in Engineering, Pearson Education, India (2001).
2. Rao, S. S., Finite element method in engineering, 5th Edition, Pergaman Int. Library of Science, 2010.
3. Huebner, K. H., The Finite Element Method for Engineers, John Wiley, New York (2001).
4. Logan, D. L., A first course in the finite element method,6th Edition, Cengage Learning, 2016.

Semester – V: Departmental Elective – I: Specialization – Thermal Engineering

Subject Code: BTME504D	I C Engine Fuel and Lubricants	LTP:300	Credits: 3

CO	Course Outcome	Bloom Taxonomy
CO 1	Explain the working principle, performance parameters and testing of IC Engine.	K 2
CO 2	Understand the combustion phenomena in SI and CI engines and factors influencing combustion chamber design.	K 2
CO 3	Understand the essential systems of IC engine and latest trends and developments in IC Engines.	K 2
CO 4	Understand the effect of engine emissions on environment and human health and methods of reducing it.	K 2
CO 5	Apply the concepts of thermodynamics to air standard cycle in IC Engines	K 3
CO 6	Analyze the effect of various operating parameters on IC engine performance.	K 4

Unit-I **(9 Hours)**

Introduction to I.C Engines: Engine classification and basic terminology, Two and four stroke engines, SI and CI engines, Valve timing diagram, Valve mechanism- Push rod type, Overhead type (SOHC,DOHC). Thermodynamic analysis of Air standard cycles: Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles Fuel air cycle, factors affecting the fuel air cycle, Actual cycle.

Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines.

Unit–II **(7 Hours)**

Combustion: Stages of Combustion in SI & CI engine, Factors affecting combustion, Flame speed, Ignition Delay, Abnormal combustion and its control.

Combustion chamber: Squish, Swirl & tumble, Combustion chamber design for SI & CI engine & factors affecting it.

Unit–III **(8 Hours)**

Carburetion, Mixture requirements, Carburetors and fuel injection system in SI Engine, MPFI, Scavenging in 2 Stroke engines.

Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings.

Turbocharging & its types- Variable Geometry Turbocharger, Waste Gate Turbocharger, Effect of turbocharging on power & emission.

Unit-IV **(9 Hours)**

Engine Emission and Control: Pollutant - Sources and types – Effect on environment and human health - formation of NOx - Hydrocarbon Emission Mechanism - Carbon Monoxide Formation - Particulate emissions - Methods of controlling Emissions - Catalytic converters and Particulate Traps - Selective Catalytic Reduction(SCR) - Diesel Oxidation Catalyst (DOC).

Fuels: Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines.

UNIT-V **(9 Hours)**

Engine Cooling and Lubrication: Different cooling systems, Radiators and cooling fans, Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation.

Ignition System in SI Engine: Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition.

Recent trends in IC engine: Lean burn engine, Stratified charge spark ignition engine, Homogeneous charge spark ignition engine, GDI.

Text Books

1. A Course in International Combustion Engines, by Mathur & Sharma, Dhanpat Rai & Sons.
2. I.C Engine, by Ganeshan, Tata McGraw Hill Publishers.

Reference Books

- I.C Engine Analysis & Practice by E.F Obert.
- Internal Combustion Engine Fundamentals, by John B. Heywood, Tata Mcgraw Hill Publishers.
- Engine Emission, by B. B. Pundir, Narosa Publication.
- Engineering Fundamentals of Internal Combustion Engines by W.W. Pulkrabek, Pearson Education.
- Fundamentals of Internal Combustion Engine by Gill, Smith, Ziurs, Oxford & IBH Publishing CO.
- Fundamentals of Internal Combustion Engines by H.N. Gupta, Prentice Hall of India.

Semester – V: Departmental Elective – I: Specialization – Automobile Engineering

Subject Code: BTME504E	Automobile Engines & Combustion	LTP:300	Credits: 3

Proposed By MIET

CO	Course Outcome	Bloom Taxonomy
CO 1	Explain the working principle, performance parameters and testing of IC Engine.	K 2
CO 2	Understand the phenomena of combustion and its application in SI and CI engines.	K 2
CO 3	Understand the essential systems of IC engine.	K 2
CO 4	Understand the effect of engine emissions on environment and human health and methods of reducing it.	K 2
CO 5	Apply the concepts of thermodynamics to air standard cycle in IC Engines	K 3
CO 6	Analyze the effect of various operating parameters on IC engine performance.	K 4

Unit-I **(8 Hours)**

Introduction to I.C Engines: Engine classification and basic terminology, Two and four stroke engines, SI and CI engines, Valve timing diagram, Valve mechanism- Push rod type, Overhead type (SOHC,DOHC).

Thermodynamic analysis of Air standard cycles: Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles Fuel air cycle, factors affecting the fuel air cycle, Actual cycle.

Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines.

Unit–II

Combustion and Flames Propagation:

(8 Hours)

Chemical composition– Flue gas analysis, Dew point of products, Stoichiometry, Stoichiometry relations, theoretical air required for complete combustion, Enthalpy of formation, Heating value of fuel, Adiabatic flame Temperature, Chemical equilibrium.

Flame stability, Burning velocity of fuels, Measurement of burning velocity, Factors affecting the burning velocity, Flame Propagation, Flame Temperature– Theoretical, Adiabatic & Actual, Ignition Limits, Limits of Inflammability.

Unit–III **(7 Hours)**

Combustion: Stages of Combustion in SI & CI engine, Factors affecting combustion, Flame speed, Ignition Delay, Abnormal combustion and its control.

Combustion chamber: Squish, Swirl & tumble, Combustion chamber design for SI & CI engine & factors affecting it.

Ignition System in SI Engine: Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition.

Unit-IV **(9 Hours)**

Carburetion, Mixture requirements, Carburetors and fuel injection system in SI Engine, MPFI, Scavenging in 2 Stroke engines.

Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings.

Turbocharging & its types- Variable Geometry Turbocharger, Waste Gate Turbocharger, Effect of turbocharging on power & emission.

UNIT-V **(8 Hours)**

Engine Emission and Control: Pollutant - Sources and types – Effect on environment and human health - formation of NOx - Hydrocarbon Emission Mechanism - Carbon Monoxide Formation - Particulate emissions - Methods of controlling Emissions - Catalytic converters and Particulate Traps - Selective Catalytic Reduction(SCR) - Diesel Oxidation Catalyst (DOC).

Fuels & Lubricants: Fuels for SI and CI engine, Rating of SI engine and CI engine fuels, Gaseous fuels, LPG, CNG, Biogas, Different cooling systems, Type of lubrication, Lubrication oils, Crankcase ventilation.

Text Books

- A Course in International Combustion Engines, by Mathur & Sharma, Dhanpat Rai & Sons.
- Fuels and combustion, Sharma and Chander Mohan, Tata McGraw Hill
- I.C Engine, by Ganeshan, Tata McGraw Hill Publishers.

Reference Books

6. I.C Engine Analysis & Practice by E.F Obert.
7. Internal Combustion Engine Fundamentals, by John B. Heywood, Tata Mcgraw Hill Publishers.
8. Engine Emission, by B. B. Pundir, Narosa Publication.
9. Engineering Fundamentals of Internal Combustion Engines by W.W. Pulkrabek, Pearson Education.
10. Fundamentals of Internal Combustion Engine by Gill, Smith, Ziurs, Oxford & IBH Publishing CO.
11. Fundamentals of Internal Combustion Engines by H.N. Gupta, Prentice Hall of India.

Semester – V: Departmental Elective – II: Specialization – Manufacturing and Automation

Subject Code: BTME505A	Advance Welding	LTP:300	Credits: 3

Course Outcome: Student will be able to		Bloom Taxonomy
CO 1	Understand the physics of arc welding process and various operating characteristics of welding power source.	K2
CO 2	Analyse various welding processes and their applications.	K3
CO 3	Apply the knowledge of welding for repair & maintenance, along with the weldability of different materials.	K3
CO 4	Apply the concept of quality control and testing of weldments in industrial environment.	K3
CO 5	Evaluate heat flow in welding and physical metallurgy of weldments.	K4

UNIT-I:

Introduction: Introduction to welding, application, classification and process selection criterion. Health & safety in welding.

Welding Arc: Physics of welding arc, arc initiation, voltage distribution, arc characteristics, arc efficiency, arc temperatures and arc blow. Mechanism and types of metal transfer.

Welding Power Sources: Types of welding power sources, operation characteristics and specifications.

UNIT-II:

Welding Processes: Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW) Gas Tungsten Arc Welding (GTAW) Plasma Arc, Submerged Arc Welding, Electro gas and Electroslag, Resistance welding, Friction welding, Brazing, Soldering & Braze welding. Laser beam welding, Electron beam welding, Ultrasonic welding, Explosive welding, Friction Stir Welding, Underwater welding.

Advances in Welding Processes: Narrow Gap, Tandem (Twin / Multi Wire) Welding, A-TIG, Hybrid Welding processes**,** Magnetically impelled arc butt (MIAB) welding**,** welding automation and robotic applications.

UNIT-III:

Heat Flow Welding: Weld thermal cycle, Temperature distribution, Peak temperature; Heat Affected Zone (HAZ), heating, cooling and solidification rates.

Welding Metallurgy: Fundamentals of physical metallurgy, Principle of solidification of weld metal, Reactions in weld pool - Gas metal reaction, Slag metal reaction, factors affecting changes in microstructure and mechanical properties of HAZ, Micro and macro structures in weld metal and HAZ

UNIT-IV:

Repair & Maintenance Welding: Hardfacing, Cladding, Surfacing, Metallizing processes and Reclamation welding.

Weldability: Effects of alloying elements on weldability, carbon equivalent, welding of plain carbon steel, Stainless steel, Cast Iron and Aluminium alloys, Welding of Dissimilar Materials

UNIT-V:

Weld Design: Types of welds & joints, Welding Symbols, Weld defects and Remedies, Residual Stresses

2. Distortion, Inspection and testing of welds: Introduction to Non Destructive Techniques; Destructive Techniques - Bulk and Microhardness test, Wear test and types, corrosion test, tensile test, bend test, SEM, EDS and XRD.

Welding Codes, WPS & PQR: Introduction to welding codes, ISO, ASME and BIS specifications, Welding Procedure Specification (WPS) & Procedure Qualification Record (PQR), Welding of pipe-lines and pressure vessels.

Books and References:

5. Welding and Welding Technology, by- Richard L. Little, McGraw Hill Education.
6. Welding Principals and Practices, by- Edwars R. Bohnart, McGraw Hill Education.
7. Welding Engineering and Technology, by- R. S. Parmar, Khanna Publishsers.
8. Welding Technology Fundamentals by William. A. Bowditch.
9. Welding Technology by N K Srinivasan.
10. Welding Engineering and Technology by R S Parmar.
11. Modern Welding Technology by Howard B Cary and Scott Helzer.
12. Welding Handbooks (Vol. I & II)
13. Advanced Welding Processes, Woodhead publishing, J. Norrish
14. ASME Sec. IX, Boiler and Pressure Vessel Code

Semester – V: Departmental Elective – II: Specialization – Automation and Industry 4.0

Subject Code: BTME505B	Programming, Data Structures And Algorithms Using Python	LTP:300	Credits: 3

Course Outcome: Student will be able to		Bloom Taxonomy
CO 1	Understand the numbers, math's function, strings, list, tuples, and dictionaries in pythons	K2
CO 2	Apply conditional statement and functions in python	K3
CO 3	Apply file handling techniques in python	K3
CO 4	Analyze the graphical demonstration in python	K4
CO 5	Apply techniques of Classes and Object Concept in Python	K3

UNIT 1: Introduction **(8 Hours)**

Introduction to Python, Python IDE's,Assignment statement, basic types - int, float, complex, bool, Strings, Lists, bytes, byte array, Functions, Loop control statements-break, continue, pass, Anonymous function-filter(),map(),reduce(), more about range().

UNIT 2: Data Structure **(7Hours)**

Arrays vs lists, Tuples and dictionaries, Sets, frozenset, Slicing,binary search, Efficiency, Selection Sort, Insertion Sort, Recursion, Mergesort, Quicksort.

UNIT 3: Function and File Handling **(8 Hours)**

Function definitions, Global scope, nested functions, Lambda Function, List Comprehension, Exception Handling, Standard input and output, Handling files, String functions, pass, del() and None

UNIT 4: Classes and Object **(8 Hours)**

Generating permutations, Stack, Queue, Circular Queue, Abstract datatypes, classes and objects, Classes and objects in Python, User defined lists, Search trees, Tree, Graph, Hashing

UNIT 5: Algorithm **(7 Hours)**

Asymptotic Notation – Big-O, Big Omega, Big Theta Notation, Memorization and dynamic programming, Grid paths, longest common subsequence, Matrix multiplication, Algorithms, and programming: simple gcd, improving naive gcd, Euclid's algorithm for gcd.

Reference Books:

4. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011

5. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist, 2nd edition, Updated for Python 3, Shroff/ OReilly Publishers, 2016

6. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016

Semester – V: Departmental Elective – II: Specialization – Design and Analysis

Subject Code: BTME505C	Mechanical Vibrations	LTP:300	Credits: 3

Course Outcome: Student will be able to		Bloom Taxonomy
CO 1	Understand fundamentals of mechanical vibrations along with their classification.	K2
CO 2	Differentiate among single, two and multiple degree of freedom (DOF) systems.	K3
CO 3	Analyze, predict and measure the performance of systems undergoing single, two and multiple DOF.	K4
CO 4	Design systems with optimized vibration absorption capabilities.	K4
CO 5	Apply the fundamentals to the real life problems like whirling of shaft	K3
CO 6	Solve complicated mathematical models using Numerical methods and software applications.	K4

UNIT – I **(10 Hours)**

Introduction, Classification of Vibration Systems, Harmonic motion, Vector representation of harmonic motion, Natural frequency & response, Effects of vibration, superposition of simple harmonic motions, beats, Fourier analysis-analytical method.

Single Degree Freedom System, Equation of motion, Newton's method, D'Alembert's principle, Energy method etc., Free vibration, Natural frequency, Equivalent systems, Displacement, Velocity and acceleration, Response to an initial disturbance, Torsional vibrations, Damped vibrations, Vibrations of systems with viscous damping, Logarithmic decrement, Energy dissipation in viscous damping.

UNIT – II **(8Hours)**

Single Degree Freedom: Forced Vibration Forced vibration, Harmonic excitation with viscous damping,steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation,Vibration isolation, Transmissibility, Vibration measuring instruments, Displacement, velocity, andacceleration measuring instruments

UNIT- III **(8Hours)**

Two Degree Freedom systems Introduction, Principal modes, Double pendulum, Torsional system withdamping, Coupled system, Principle of vibration absorber, Undamped dynamic vibration absorbers,Torsional vibration absorber, Centrifugal pendulum absorbers, Vibration isolators and Dampers.

UNIT- IV **(10 Hours)**

Multi-degree Freedom system: Exact Analysis, Undamped free and forced vibrations of multi-degree freedom systems, influence coefficients, Reciprocal theorem, Torsional vibration of multi-degree rotor system, Vibration of gear system, Principal coordinates, Continuous systems- Longitudinal vibrations of bars, Torsional vibrations of circular shafts.

Multi Degree Freedom system: Numerical Analysis by Rayleigh's method, Dunkerley's, Holzer's and Stools methods, Rayleigh-Ritz method.

UNIT- V **(8Hours)**

Critical speed of shafts, Whirling of uniform shaft, Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed.

Industrial case studies (any two) involving mechanical vibrations, their impact and performance analysis.

Introduction to the vibration analysis using MATLAB.

Books and References:

i. Mechanical Vibrations- V.P. Singh, Dhanpat rai & Co.
ii. Mechanical Vibrations- G. K. Grover, Jain Brothers, Roorkee.
iii. Mechanical Vibrations- Kelly

iv. Mechanical Vibrations- Tse, Morse & Hinkle
v. **Case study Reference#1**: https://www.ijstr.org/final-print/july2018/Vibration-Analysis-Of-Rotating-Machines-With-Case-Studies.pdf

vi. **Case study Reference#2:** https://www.researchgate.net/publication/254227083_Case_studies_of_vibrations_in_structure s

vii. **Case study Reference#3:** https://pdfs.semanticscholar.org/f2b6/39990c4ba52706f43d02fe1c59b9c3fabf2a.pdf
viii. **MOOC reference:**https://www.youtube.com/playlist?list=PLSGws_74K01_pG3R7rgtDtrDZBjcTgPdR

Recommended software packages:

1. MATLAB
2. Any modelling and FEA tool like NX, Solid works etc.

Semester – V: Departmental Elective – II: Specialization – Thermal Engineering

Subject Code: BTME505D	Fuels and Combustion	LTP:300	Credits: 3

	The students will be able to	Blooms Taxonomy
CO1	Understand the properties of different types of fuel with their application.	K2
CO2	Classify different types of fuels.	K2
CO3	Understand the concept of combustion.	K2
CO4	Understand the fundamental concept of air pollution and its control.	K2
CO5	Calculate various properties of the fuels.	K3
CO6	Analyze the flue gases.	K4

Unit-I

Classification and Properties of Fuels:

Fuels-Types and characteristics of fuels-Determination of properties of fuels-Fuel analysis Proximate and ultimate analysis-Calorific value (CV), Gross and net calorific values (GCV,NCV)- Bomb Calorimetry-empirical equations for CV estimation

Solid Fuels:

Origin of coal-Ranking of coal-Washing, cleaning, and storage of coal-Renewable Solid Fuels comparative study of Solid, liquid and gaseous fuels-selection of coal for different industrial applications-carbonization of coal

Unit-II

Liquid Fuels:

Origin of crude oil-composition of crude petroleum-classification of crude petroleum-Removal of salt from crude oil-processing of crude petroleum-Fractionation distillation ADU and VDU Cracking-Hydrotreatment and Reforming

Gaseous Fuels:

Rich and lean gas-Wobbe index-Natural gas-Dry and wet natural gas-Foul and sweet NG-LPGLNG-CNG- Methane-Producer Gas-Water gas-Coal Gasification-Gasification Efficiency

Unit-III: Combustion and Flames Propagation

Chemical composition– Flue gas analysis, Dew point of products, Stoichiometry, Stoichiometry relations, theoretical air required for complete combustion, Enthalpy of formation, Heating value of fuel, Adiabatic flame Temperature, Chemical equilibrium.

Flame stability, Burning velocity of fuels, Measurement of burning velocity, Factors affecting the burning velocity, Flame Propagation – Solid, Liquid & Gaseous Fuels Combustion, Flame Temperature– Theoretical, Adiabatic & Actual, Ignition Limits, Limits of Inflammability.

Unit-IV: Combustion Equipment

Analysis of flue gases by Orsat apparatus-Combustion of solid fuels-grate firing and pulverized fuel firing system-Fluidized bed combustion-Circulating fluidized bed boiler, Oil Burners, Gas Burners, Factors affecting burners and combustion, Combustion in I.C. Engines, Combustion in gas turbine and jet engines

Unit-V: Air Pollution

Types of pollution, Combustion generated air pollution, Effects of air pollution, Pollution of fossil fuels and its control, Pollution from automobiles and its control, Emission by diesel engines, Emission Standards.

Text book (s):

1 Kenneth K.K., Principles of Combustion, 2nd ed., Wiley Publications, USA, 2012

2 Sharma and Chander Mohan, Fuels and combustion, Tata McGraw Hill

3 Phillips H.J., Fuels-solid, liquid, and gases–Their analysis and valuation, 1st ed., Foster Press, USA, 2010

4. Speight J.G., The Chemistry and Technology of Coal, 3rd ed., Taylor and Francis Ltd., USA, 2016

5. Sarkar S., Fuels and combustion, 3rd ed., Universities Press, India, 2009

Semester – V: Departmental Elective – II: Specialization – Automobile Engineering

Subject Code: BTME505E	Automotive chassis and suspension	LTP:300	Credits: 3

Course Outcomes: The students will be able to		Blooms Taxonomy
CO-1	Understand different types of automotive chassis and frames used in automobiles.	K2
CO-2	Understand transmission and drive line components used in automobile.	K2
CO-3	Understand the axles and types of steering system in automobile.	K2
CO-4	Understand the constructional features of barking, suspension system, wheels and tyres in automobile application.	K2
CO-5	Understand the recent advancements made in chassis components of automobile.	K2
CO-6	Apply the concepts of braking and steering system to design the same for automobile application.	K3

Unit I

Chassis Layouts and Frames

Definition of Chassis, Types of Chassis Layout with reference to Power Plant Location and Drive

Automotive Frames - Material Selection and its Constructional Details, Various types, Different Loads acting on Frame, Testing of Automotive Frames.

Unit II

Transmission: Clutches- Requirements and its types, Gear Box: Need and requirements, Types of manual gear boxes, Gear ratio Calculation.

Drive Line: Propeller Shaft - Design Considerations & Constructional Details, Universal Joints, Constant Velocity Joints, Hotchkiss Drive, Torque Tube Drive, Radius Rods and Stabilizers, Final drive - Different

types, Multi-axle Vehicles, Differential - Working Principle and Constructional Details, Non–Slip Differential, Differential Locks.

Unit III

Suspension System: Need; factors influencing ride comfort; types; suspension springs-leaf spring, coil spring & torsion bar; spring materials; independent suspension; rubber suspension; pneumatic suspension; hydraulic suspension, shock absorbers-liquid & gas filled.

Braking Systems: Stopping Distance, Braking Efficiency, Weight Transfer during Braking, Drum Brakes - Constructional Details, Leading and Trailing Shoe, Braking Torque, Disc Brake - Types and Constructional Details, Hydraulic Braking System, Pneumatic Braking System, Power–Assisted Braking System, Factors affecting brake performance, operating temperature, Area of brake lining, clearance.

Unit IV

Axles: Live and Dead Axles, Constructional Details, Different Types of Loads acting on Drive Axles, Rear Axle Shaft Supporting Types: Semi Floating, Full Floating, Three Quarter Floating, Axle Housings and Types

Steering System: Types of Front Axles and Stub Axles, Front Wheel Geometry, Condition for True Rolling Motion of Wheels during Steering, Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over Steer and Under Steer, Reversible and Irreversible Steering, Hydraulic Power Assisted Steering, Turning Radius Calculation.

Unit V

Wheels and Tyres: Types of Wheels, Construction, Structure and Function, Forces acting on wheels, Wheel Dimensions, Wheel Balancing, and Wheel Alignment. Structure and Function of Tyres, Static and Dynamic Properties of Pneumatic Tyres, Types of Tyres, Materials, Tyre Section & Designation, Factors affecting Tyre Life, Tyre Rotation.

Bearings: Functions; classification of bearings; bearing materials; automotive bearings.

Recent Trends in Chassis Systems: Special Steering Columns, 4 wheel steering system, Electric Power Steering, Anti–Lock Braking System, Traction Control Systems, Electronic Brake force Distribution Systems, Corner Stability Control, Hill Assist, and Autonomous Braking System.

Text Books:

11. Automobile engineering", Dr. Kripal Singh.
12. Automobile engineering" R.B. Gupta, Satya Prakashan.

References:

1 Heldt P.M., "Automotive chassis", Chilton Co., New York.
2 Giles J.G., "Steering, Suspension and tyres", Iliffe Book Co., London.
3 A.K. Babu, Automotive Mechanics, Khanna Publishing House

Internship Assessment

Subject Code: BTME509P

Semester -VI

Subject Code: BTME 601	Refrigeration & Air Conditioning	LTP:310	Credits: 4

The students will be able to		Blooms Taxonomy
CO1	Understand the basics concepts of Refrigeration & Air-Conditioning and its future prospects.	K2
CO2	Explain the construction and working of various components in Refrigeration & Air-Conditioning systems.	K2
CO3	Understand the different types of RAC systems with their respective applications.	K2
CO4	Apply the basic laws to the thermodynamic analysis of different processes involved in Refrigeration and Air-Conditioning.	K3
CO5	Apply the basic concepts to calculate the COP and other performance parameters for different RAC systems	K3
CO6	Analyze the effects of performance parameters on COP.	K4

8 Hours

Unit-1

Refrigeration:

Introduction to refrigeration system, Methods of refrigeration, Unit of refrigeration, Refrigeration effect, Carnot refrigeration cycle, Refrigerator and Heat Pump, C.O.P.

Air Refrigeration cycle:

Open and closed air refrigeration cycles, Reversed air Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Need of Aircraft refrigeration, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART).

Unit-2 **8 Hours**

Vapour Compression System:

Reversed vapour Carnot cycle, limitation of Reversed vapour Carnot cycle, Simple vapour compression cycle, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle,

Multistage System:

Multistage vapour compression system requirement, Different configuration of multi pressure system, Removal of flash gas, Intercooling, Multi evaporator system, Cascade system.

Unit-3

Vapour Absorption system;

Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram , Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium-Bromide water vapour absorption system, Comparison, Three fluid syst **Refrigerants:**

Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants, and Environment friendly refrigerants, Anti-freeze solution, Phase changing materials, Ozone layer depletion and global warming considerations of refrigerants, Selection of refrigerants, Future Refrigerants like Hydrofluoro-Olefines**8 Hours**

Unit-4

Air Conditioning:

8 Hours

Introduction to air conditioning, Psychrometric properties and their definitions, Psychrometric chart, Different Psychrometric processes, Air Washers, Cooling towers & humidifying efficiency, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP).

Window air Conditioner, Simple air conditioning system, Air conditioning system with ventilation.

Unit-5

Refrigeration System Equipment:

8 Hours

Compressors, Condensers, Expansion Devices and Evaporators, Elementary knowledge of transmission and distribution of air through ducts and fans,

Application:

Food preservation, Transport refrigeration, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Comfort and Industrial air conditioning Refrigeration.

Other systems:

Cryogenic liquefaction and refrigeration systems, Brief introduction of Thermo-electric refrigeration system, Steam jet refrigeration system, Vortex tube refrigeration system, Magnetic refrigeration system.

Reference Books:

2 Refrigeration and Air conditioning by C.P Arora, McGraw-Hill
3 Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd. Pub.
1. Refrigeration and Air conditioning by R.C. Arora, PHI

6. Principles of Refrigeration by Roy J. Dossat. Pearson Education
7. Refrigeration and Air conditioning by Stoecker & Jones. McGraw-Hill
8. Refrigeration and Air conditioning by Arora & Domkundwar. DhanpatRai
9. Thermal Environment Engineering. By Kuhen, Ramsey &Thelked
em.

Subject Code: BTME 602	Machine Design	LTP:310	Credits: 4

Course Outcomes: The student will be able to		Blooms Taxonomy
CO 1	Recall the basic concepts of Solid Mechanics to understand the subject.	K2
CO 2	Classify various machine elements based on their functions and applications.	K2
CO 3	Apply the principles of solid mechanics to machine elements subjected to static and fluctuating loads.	K3
CO 4	Analyze forces, bending moments, twisting moments and failure causes in various machine elements to be designed.	K4
CO 5	Design the machine elements to meet the required specification.	K5

Unit I **8 Hours**

Introduction

Definition, Design requirements of machine elements, Design procedure, Standards in design, Standards designation of carbon & alloy steels, Selection of preferred sizes, Selection of materials for static and fatigue loads, Design against Static Load

Design against Fluctuating Loads

Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Design for finite & infinite life, Soderberg, Goodman, Gerber criteria

Unit II

Riveted Joints 8 Hours

Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint

Welded Joints

Stress relieving of welded joints, Butt Joints, Fillet Joints, Strength of Butt Welds, Strength of parallel fillet welds, Strength of transverse fillet welds

Shafts

Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity, Keys, Types of keys, Selection of square and flat keys, Strength of sunk key

Unit III

Spur Gears

8 Hours

Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards.

Helical Gears

Terminology, Proportions for helical gears, Force components on a tooth of helical gear, Virtual number of teeth, Beam strength and wear strength of helical gears, Dynamic load on helical gears, Design of helical gears.

Introduction, Classification and Applications of Bevel & Worm Gears

Unit IV **8 Hours**

Sliding Contact Bearing

Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing.

Rolling Contact Bearing

Advantages and disadvantages, Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing.

Unit V

IC Engine Parts

Selection of type of IC engine, General design considerations, Design of Cylinder and cylinder head; Design of piston, piston ring and gudgeon pin;

Friction Clutches

Clutches, Difference between coupling and clutch, Single plate friction clutch, Torque transmitting capacity, Multi-Disk Clutches, Friction Material

Note: Design data book is allowed in the examination

Text Books:

8: Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill Co.
9: Design of Machine Elements, Sharma and Purohit, PHI.

Reference Books:

(vi) Mechanical Engineering Design, 9e – Joseph E. Shigely, McGraw Hill Education.
(vii) Machine Design-Maleev and Hartman, CBS Publishers.

(viii) Design of Machine Design-M.F. Spott, Pearson Education.
(ix) Elements of Machine Component Design, Juvinal & Marshek, John Wiley & Sons.
(x) Machine design, Robert L. Norton, Pearson Education
(xi) Theory & Problem of Machine Design (Schaum's Outline Series) Hall, Holowenko, Laughlin, Tata McGraw Hill Co.

(xii) Machine Design-Sharma and Agrawal, S.K. Kataria & Sons.
(xiii) Machine Design, U C Jindal, Pearson Education.

Subject Code: BTME 603	Theory of Machines	LTP:310	Credits: 4

Course Outcomes: The students will be able to		Blooms Taxonomy
CO1	Understand the principles of kinematics and dynamics of machines.	K2
CO2	Calculate the velocity and acceleration for 4-bar and slider crank mechanism	**K3**
CO3	Develop cam profile for followers executing various types of motions	K3
CO4	Apply the concept of gear, gear train and flywheel for power transmission	K3
CO5	Apply dynamic force analysis for slider crank mechanism and balance rotating & reciprocating masses in machines.	K3
CO6	Apply the concepts of gyroscope, governors in fluctuation of load and brake & dynamometer in power transmission	K3

Unit I **(09 Hours)**

Introduction, mechanisms and machines, kinematics and kinetics, types of links, kinematic pairs and their classification, types of constraint, degrees of freedom of planar mechanism, Grubler's equation, mechanisms, inversion of four bar chain, slider crank chain and double slider crank chain.

Velocity analysis: Introduction, velocity of point in mechanism, relative velocity method, velocities in four bar mechanism, instantaneous center.

Acceleration analysis: Introduction, acceleration of a point on a link, acceleration diagram, Corioli's component of acceleration, crank and slotted lever mechanism,.

Unit II **(10 Hours)**

Cams: Introduction, classification of cams and followers, cam profiles for knife edge, roller and flat faced followers for uniform velocity, uniform acceleration

Gears and gear trains: Introduction, classification of gears, law of gearing, tooth forms and their comparisons, systems of gear teeth, length of path of contact, contact ratio, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, sun and planet gear train.

Unit III **(08 Hours)**

Force analysis: Static force analysis of mechanisms, D'Alembert's Principle, dynamics of rigid link in plane motion, dynamic force analysis of planar mechanisms, piston force and crank effort. Turning moment on crankshaft

due to force on piston, Turning moment diagrams for single cylinder double acting steam engine, four stroke IC engine and multi-cylinder engines, Fluctuation of speed, Flywheel.

Unit IV **(09 Hours)**

Balancing: Introduction, static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of reciprocating masses, balancing of single cylinder engine.

Governors: Introduction, types of governors, characteristics of centrifugal governors, gravity controlled and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors. Effort and Power of governor

Unit V (09 Hours)

Brakes and dynamometers: Introduction, Law of friction and types of lubrication, types of brakes, effect of braking on rear and front wheels of a four wheeler, dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer

Gyroscope: Space motion of rigid bodies, angular momentum, gyroscopic couples, gyroscopic stabilization, ship stabilization, stability of four wheel and two wheel vehicles moving on curved paths.

Text / Reference Books

10. Kinematics and dynamics of machinery: Wilson and Sadler, Third edition, Pearson.
11. Theory of Mechanisms and Machines: Amitabh Ghosh and Ashok Kumar Mallik, Third Edition Affiliated East-West Press.
12. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Oxford University Press
13. Kinematics and dynamics of machinery: R L Norton, McGraw Hill
14. Theory of Machines: S.S. Rattan, McGraw Hill
15. Theory of Machines: Thomas Bevan, CBS Publishers.

Suggested Software

MechAnalyzer

Subject Code: BTME 606P	Refrigeration & Air Conditioning Lab	LTP:002	Credits: 1

The students will be able to:		Blooms Taxonomy
CO1	Determine the performance of different refrigeration and air-conditioning systems.	K3
CO2	Apply the concept of psychrometry on different air cooling systems.	K3
CO3	Interpret the use of different components, control systems and tools used in RAC systems	K3
CO4	Demonstrate the working of practical applications of RAC systems.	K2

Minimum eight experiments out of the following:

1. Experiment on refrigeration test rig and calculation of various performance parameters.
2. Experiment on air-conditioning test rig & calculation of various performance parameters.
3. Study of Psychrometer and determination of humidity of air using Sling Psychrometer.
4. To study and perform experiment on vapour absorption apparatus.
5. To study the air washer and perform different psychometric processes on air washer.
6. Study of desert coolers and determine the change in temperature and humidity of ambient air.
7. Handling, use and familiarization with refrigeration tools and accessories such as: Tube cutter; Tube bender [spring type]; Flaring tool; Swaging tool; Pinch off etc.
8. Study of window air conditioner.
9. Study of Hermetically sealed compressor.
10. To study basic components and control devices of refrigeration and air-conditioning system.
11. Experiment on Ice-plant and calculation of various performance parameters.
12. Visit of a central air conditioning plant and its detailed study.
13. Visit of cold-storage and its detailed study.

Subject Code: BTME 607P	Machine Design Lab	LTP:002	Credits: 1

Course Outcomes: The student will be able to		Blooms Taxonomy
CO-1	Apply the principles of solid mechanics to design various machine Elements subjected to static and fluctuating loads.	**K3**
CO-2	Write computer programs and validate it for the design of different machine elements	**K4**
CO-3	Evaluate designed machine elements to check their safety.	**K5**

A Design of Machine Elements

5. Design a knuckle joint subjected to given tensile load.
6. Design a riveted joint subjected to given eccentric load.
7. Design of shaft subjected to combined constant twisting and bending loads
8. Design a transverse fillet welded joint subjected to given tensile load.
9. Design & select suitable Rolling Contact Bearing for a shaft with given specifications
10. Design a cylinder head of an IC Engine with prescribed parameters.
11. Design of Piston & its parts of an IC Engine

B. Computer Programs for conventional design

Computer and Language: Students are required to learn the basics of computer language such as C/C++/MATLAB so that they should be able to write the computer program.

12. Design a pair of Spur Gear with given specifications to determine its various dimensions using Computer Program in C/C++.
13. Design a pair of Helical Gear with given specifications to determine its various dimensions using Computer Program in C/C++.
14. Design of Sliding Contact Bearing with given specifications & determine its various parameters using Computer Program in C/C++.

Subject Code: BTME 608P	Theory of Machines Lab	LTP:002	Credits: 1

The students will be able to:		Blooms Taxonomy
CO1	Demonstrate various mechanisms, their inversions and brake and clutches in automobiles	K2
CO2	Apply cam-follower mechanism to get desired motion of follower.	K3
CO3	Apply the concepts of gears and gear train to get desired velocity ratio for power transmission.	K3
CO4	Apply the concept of governors to control the fuel supply in engine.	K3
CO5	Determine the balancing load in static and dynamic balancing problem	K3

List of Experiments

(Minimum eight experiments out of the following)

NOTE: Student has to write computer program in C / C++ / Python and to run to compute the output values for at least ONE experiments.

1. To study various types of kinematics links, pairs, chains & Mechanisms
2. To study Whitworth Quick Return Motion Mechanisms, Reciprocating Engine Mechanism, and Oscillating Engine Mechanism
3. To study of inversions of four bar linkage
4. To study of inversions of single/double slider crank mechanisms
5. To study various types of gear (Helical, cross helical, worm, bevel gear) and gear profile (involute and cycloidal) and condition for interference Helical, cross helical, worm, bevel gear
6. To compute the output velocity invarious gear trains
7. To study gyroscopic effects through models
8. To determine gyroscopic couple on Motorized Gyroscope
9. To perform experiment on dead weight type governor to prepare performance characteristic Curves, and to find stability & sensitivity
10. To perform experiment on spring controlled governor to prepare performance characteristic Curves, and to find stability & sensitivity
11. To determine whirling speed of shaft theoretically and experimentally
12. To perform the experiment for static / dynamic balancing

13. To perform experiment on brake
14. To perform experiment on clutch
15. To perform the experiment for static / dynamic balancing.
16. To perform experiment on longitudinal vibration
17. To perform experiment on transverse vibration

Semester – VI: Departmental Elective – III: Specialization – Manufacturing and Automation

Subject Code: BTME604A	Nondestructive Testing	LTP:300	Credits: 3

Course Outcome: Student will be able to		Bloom Taxonomy
CO 1	Understand the concept of destructive and Non-destructive testing methods.	K2
CO 2	Explain the working principle and application of die penetrant test and magnetic particle inspection.	K2
CO3	Understand the working principle of eddy current inspection.	K2
CO 4	Apply radiographic techniques for testing.	K3
CO 5	Apply the principle of Ultrasonic testing and applications in medical and engineering areas.	K3

Unit-I:

Introduction to NDT, DT, advantages & limitations of NDT, classification of NDT methods, Comparison with DT, Terminology, Flaws and Defects. Scope of NDT. Codes, Standards and Certifications in NDT.

Visual Inspection– Equipment used for visual inspection, Borescopes, Application of visual inspection tests in detecting surface defects and their interpretation, advantages & limitations of visual inspection, Visual Inspection in Welding.

Unit-II:

Liquid Penetrant Testing – Principle, Scope, Testing equipment, Advantages, Limitations, types of penetrants and developers, standard testing procedure, Zyglo test, Illustrative examples and interpretation of defects.

Magnetic Particle Inspection – Principle, Scope, Testing equipment, Advantages, Limitations, Application of MPI & standard testing procedure, DC & AC magnetization, Skin Effect, different methods to generate magnetic fields, Illustrative examples and interpretation of defects.

Unit-III:

Radiographic Testing – Introduction to electromagnetic waves and radioactivity, various decays, Attenuation of electromagnetic radiations, Photoelectric effect, coherent scattering and Incoherent scattering, Beam geometry.

X-ray Radiography – Principle, equipment & methodology, applications, source, types of radiations and limitations; γ-ray Radiography – Principle, equipment, γ-ray source & technique; Radiography Image Quality

Indicators, Film Processing, advantages of γ-ray radiography over X-ray radiography. Precautions against radiation hazards.

Unit-IV:

Ultrasonic Testing – Introduction, Principle, Piezoelectricity and Piezoelectric Transducers, Wave propagation, Ultrasonic probes, selection of angle probes, Acoustic Impedance, Reflection and transmission coefficient, Snell's law, standard testing procedure & calibration, advantages & limitations. Data representation - A-scan, B-scan, C-scan. Applications in inspection of welded joints, castings, forgings and dimensional measurements. Introduction to TOFD & Phased Array Ultrasonic Testing.

Unit-V:

Special NDT Techniques:

Eddy Current Inspection– Introduction, Principle, Methods, scope, Equipment, types of probes, Sensitivity, standard testing procedure, advanced ECT methods, advantages and limitations.

Acoustic Emission Technique– Introduction, Types of AE signal, Principle, Advantages & Limitations, Interpretation of Results, Applications.

Holography, Thermography– Introduction, Principle, advantages, limitations and applications.

Books and References:

6. Non-Destructive Testing and Evaluation of Materials, by- Prasad, Mc Graw Hill Education.
7. Practical Non-destructive Testing, by- Baldev Raj, T. Jayakumar, M. Thavasimuthu, Woodhead Publishing.
8. Non-Destructive Testing Techniques, by- Ravi Prakash, New Age International.
9. Non destructive Testing Handbook, by Robert C. McMaster, American Society for Nondestructive.
10. Introduction to Non destructive Testing: A Training Guide, by- Paul E. Mix, wiley.
11. Electrical and Magnetic Methods of Non-destructive Testing, by- J. Blitz, springer.
12. Practical non destructive testing by Raj, Baldev.
13. Basics of Non-Destructive Testing, by Lari & Kumar, KATSON Books.
14. ASME Sec. V, boiler and pressure vessel code

Semester – VI: Departmental Elective – III: Specialization – Automation and Industry 4.0

Subject Code: BTME604B	Artificial Intelligence	LTP:300	Credits: 3

Course Outcomes: Students are able to		Bloom's Taxonomy
CO 1	Understand concepts of Artificial Intelligence	K2
CO 2	Solve problem by Search-I & Search-II	K3
CO 3	Understand Knowledge representation	K2
CO 4	Apply concepts of Learning methods	K3
CO 5	Analyse Decision Networks	K4
CO 6	Build planning graphs	K5

(9Hours)

Unit 1:

Introduction of Artificial Intelligence, Intelligent Agents,and Behaviors of Artificial Agents, Structure of Intelligent Agents. Problem solving and state space search, Uninformed Search, Heuristic search, Best- First Search, Heuristic Functions, Constraints satisfaction problem, Iterative Improvement Algorithms.

(Recommended lab practice sessions: Games as Search Problems, Alpha-Beta Pruning, State-of-the-Art Game Programs.)

Unit 2: **(8Hours)**

Introduction to Knowledge Representation, Propositional Logic, 1st order logic-I, 1st order logic-II, Inference in First-Order Logic, Using First-Order Logic, Building a Knowledge Base, Logical Reasoning Systems; Indexing, Retrieval, and Unification, Inference in FOL-II, Answer Extraction.

Unit 3: **(9Hours)**

Procedural control of reasoning, reasoning under uncertainty, Bayesian Networks, Decision Networks, Uncertain knowledge and reasoning, The Axioms of Probability, Bayes' Rule and Its Use, Probabilistic Reasoning Systems, Making Simple Decisions, Making Complex Decisions, Introduction to Planning, Practical Planning and Acting, Inductive Learning, Learning from Observations.

Unit 4: **(7Hours)**

Neural Networks: Learning in Neural Networks, How the Brain Works, Perceptron, Multilayer Feed- Forward Networks, Applications of Neural Networks, Introduction to Learning, Kinds of Learning, Supervised and Unsupervised Learning, Clustering, Reinforcement Learning.

Learning a Function, Aspects of Function Learning, and Types of function learning aspects: Memory, Averaging and Generalization, Example problems based on Function Learning.Learning methods, Nearest Neighbor, Decision Trees, and Neural Networks.

Unit 5: **(7Hours)**

Intelligent Agents, Types of Communicating Agents, A Communicating Agent, Practical Natural Language Processing: Practical Applications, Efficient Parsing, Scaling Perception: Image-Processing Operations for Early Vision, Using Vision for Manipulation and Navigation, Speech Recognition.Robotics: Tasks: What Are Robots Good For? Parts: What Are Robots Made Of? Architectures, Configuration Spaces: A Framework for Analysis, Navigation and Motion Planning

Text Book:

Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education

Reference Books:

1. Elaine Rich and Kevin Knight, "Artificial Intelligence", McGraw-Hill
2. E Charniak and D McDermott, "Introduction to Artificial Intelligence", Pearson Education
3. Dan W. Patterson, "Artificial Intelligence and Expert Systems", Prentice Hall of India,

Semester – VI: Departmental Elective – III: Specialization – Design and Analysis

Subject Code: BTME604C	Tribology	LTP:300	Credits: 3

Course Outcome: Student will be able to		Bloom Taxonomy
CO 1	Identify and explain various friction and wear mechanisms.	K2
CO 2	Select proper lubricants for different applications.	K3
CO 3	Select suitable lubrications methods in different bearings.	K3
CO 4	Study the surfaces coating techniques for reduction of wear.	K3
CO 5	Analyze the impact of friction in various kinematic pairs.	K4

UNIT –I Lubrication and Lubricants

Introduction to tribology, tribology in industry, basics modes of lubrication, oil viscosity, temperature and pressure dependence of viscosity, Viscosity index, viscosity measurement, properties of lubricants, temperature characteristics of lubricants, lubricant impurities and contaminants, mineral oils based lubricants, synthetic oils based lubricants, emulsions and aqueous lubricants, greases, and lubricant additives.

UNIT –II Friction and Wear

Friction-causes of friction, theories of dry friction; adhesion theory, abrasive theory, junction growth theory, laws of rolling friction, friction measurement, friction instabilities.

Wear- classification; abrasive wear, erosive wear, cavitation wear, adhesive wear, corrosive wear, oxidative wear, fatigue wear, factors affecting wear, measurement of wear, theories of wear, approaches to friction control and wear prevention.

UNIT –III Lubrication of Bearings

Theory of hydrodynamic lubrication, mechanism of pressure development in oil film, jet lubrication, mist lubrication, lubrication utilizing under race passage, concept of journal bearing, minimum oil film thickness, porous bearings, flat plate thrust bearing, tilting pad bearings, hydrostatic lubrication, squeeze film lubrication, elasto-hydrodynamic lubrication, rolling element bearings, gas lubricated bearings, and hybrid bearings.

UNIT –IV Solid Lubrication and Surface Treatment

Lubrication by solids, friction and wear characteristics of lamellar solids, reduction of friction by soft metallic films, deposition methods of solid lubricants, techniques for producing wear resistant coatings, characteristics of wear resistant coatings.

UNIT –V Friction, Lubrication and Wear in Kinematic pairs

The concept of friction angle, friction stability, friction in slideways, friction in screws with square threads, friction in screws with triangular threads, mechanism and operation of plate clutch, cone clutch, rim clutch, centrifugal clutch, and belt drives, tribodesign aspects of labyrinth seals, analysis of line contact lubrication, analysis of point contact lubrication, cam follower system, traction in the contact zone, and hysteresis losses.

Books and References:

1) Fundamentals of Engineering Tribology with Applications by Harish Hirani, Cambridge English (2017)
2) Applied Tribology (Bearing Design and Lubrication), by Michael M Khonsari, John Wiley & Sons (2001).
3) Principles of Tribology, by J Halling, The Macmillan Press Ltd,London, (1975).
4) Friction, Wear, Lubrication:A textbook in Tribology, by Ludema K C, CRC Press, (2010).
5) Fundamentals of Machine Elements, B.J. Hamrock, B.O. Jacobson & S.R. Schmid, McGraw-Hill Inc., (1998).
6) Fundamentals of Mechanical Component Design, by K.S. Edwards & R.B. McKee, McGraw-Hill Inc., (1991).
7) Mechanical Engineering Design by J.E. Shigley and C R Mischke, Tata McGraw-Hill Publishing Company Limited, (2003).
8) Tribophysics, by N.P. Suh Prentice-Hall, (1986).
9) Friction, Wear, Lubrication: A Textbook in Tribology, by Kenneth C Ludema, LayoAjayi, CRC Press (2019).

Semester – VI: Departmental Elective – III: Specialization – Thermal Engineering

Subject Code: BTME604D	Gas Dynamics and Jet Propulsion	LTP:300	Credits: 3

Course Outcomes: The students will be able to		Blooms Taxonomy
CO1	Understand the concept of compressible fluid flow and flow through variable area ducts.	K2
CO2	Understand the basic principle and types of jet and rocket propulsion.	K2
CO3	Apply the basic laws for the investigation of flow through ducts.	K3
CO4	Apply the basic laws for the thermodynamics analysis of jet and rocket propulsion.	K3
CO5	Analyze the compressible flow through variable area ducts.	K4

UNIT -I:

Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow.

UNIT-II:

Isentropic flow through variable area ducts, nozzles and diffusers, subsonic and supersonic flow variable area ducts, choked flow, Area-Mach number relations for isentropic flow.

UNIT -III:

Non-isentropic flow in constant area ducts, Rayleigh and Fano flows, Normal shock relations, oblique shock relations, isentropic and shock tables.

UNIT -IV:

Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

UNIT -V:

Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, space flights.

Books and References:

1. Ahmed F. El-Sayed, Aircraft Prpoulsion and Gas Turbine Engines, CRC Press, 2008.
2. H.S. Mukunda, "Understanding Aerospace Chemical Propulsion", Interline Publishing,2004.
3. Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley,1992.
4. Zucrow N. J., Aircraft and Missile Propulsion, Vol.I& II, John Wiley, 1975.
5. Sutton G.P., Rocket Propulsion Elements, John Wiley, New York, 1986.

Semester – VI: Departmental Elective – III: Specialization – Automobile Engineering

Subject Code: BTME604E	Automotive Electrical and Electronics	LTP:300	Credits: 3

The students will be able to		Blooms Taxonomy
CO-1	Understand the basic concepts of electrical systems used in automobile.	K2
CO-2	Understand the constructional features of charge storage devices and methods to test these devices for their healthy operation.	K2
CO-3	Understand the principles and characteristics of charging and starting system of automobile and study the various faults occurring in system.	K2
CO-4	Understand the ignition and auxiliary system- types & constructional features used in automobile.	K2
CO-5	Describe the principles and architecture of electronics systems and its components present in an automobile related to data transfer, instrumentation, control, and security systems.	K2
CO-6	Understand latest trends developed in electrical and electronic systems of automobile and their advantages over conventional technologies.	K2

[L 8 Hours]

Unit 1

Introduction to electrical fundamentals – Ohm's Law, Kirchhoff's Law, Capacitance and Inductance, Simple Electric Circuits, Automotive Wiring Harnesses, Insulated and Earth Return System, Positive and Negative Earth Systems, Connectors and its types

Charge storing devices- Principle and construction of Lead Acid Battery, Nickel – Cadmium Battery, Nickel Metal, Hybrid Battery, Sodium Sulphur Battery and Aluminum Air Battery-Choice of Batteries for automotive applications, Characteristics of Battery, Battery Rating, Capacity and Efficiency, Various Tests on Battery, Battery– Charging Techniques. Maintenance of batteries.

Unit 2 **[L 8 Hours]**

Starter Systems- Requirements of Starter Motor, Starter Motor types, construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids.

Charging system components, Generators and Alternators, types, construction and Characteristics,

Charging System- Voltage and Current Regulation, Cut –out relays and regulators, Charging circuits for D.C. Generator, A.C. Single Phase and Three – Phase Alternator

Unit 3 **[L 8 Hours]**

Automotive Ignition Systems: Spark Plugs, Constructional details and Types, Battery Coil and Magneto– Ignition System Circuit details and Components, Centrifugal and Vacuum Advance Mechanisms, Non– Contact– type Ignition Triggering devices, Capacitive Discharge Ignition, Distributor–less Ignition Systems

Auxiliary Systems: Head Lamp and Indicator Lamp construction and working details, Focusing of head lamps, Anti– Dazzling and Dipper Details, Automotive Wiring Circuits. Indicators and meters, speedometers, electric horn, windshield wiper, electric horn and relay devices.

Unit 4 **[L 8 Hours]**

Automotive Electronics: Automotive networking, Bus system, Advantages of bus systems, requirements of buses, Buses in motor vehicle: CAN, FlexRay, LIN, Ethernet, IP, PSI5, MOST bus and optical fibers/wave guides, Architectures of electronic system.

Control Units: ECM, ABS control unit, Steering Control Unit, SRS control unit, Automatic Air Conditioning Control Unit.

Unit 5 **[L 8 Hours]**

Automotive Sensors and Actuators: Basic principle, Main requirements, Micromechanics, Position sensors, Speed and RPM sensors, Acceleration and vibration sensors, Pressure sensors, Flow meters, Gas sensors, concentration sensors, temperature sensors, Force sensors, Optoelectronics sensors, Sensors for driver assistance systems: Ultrasonic technology, Radar technology, LIDAR sensors Purge Control, Idling Setting Control, Immobilizer System, Stepper motors.

Books:

1. Automotive Electricals by PL Kohli, McGraw Hill Publications.
2. Robert Bosch "Automotive Hand Book", SAE (8th Edition), 2011.

References:

1. Tom Denton, "Automobile Electrical and Electronic Systems" 4th edition- Routledge - 2012.
2. Barry Hollembeak, "Automotive Electricity and Electronics", Delmar Cengage Learning; 5th edition, 2011

Real Time Systems
BTOE-605A

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Describe concepts of Real-Time systems and modeling.
2. Recognize the characteristics of a real-time system in context with real time scheduling.
3. Classify various resource sharing mechanisms and their related protocols.
4. Interpret the basics of real time communication by the knowledge of real time models and protocols.
5. Apply the basics of RTOS in interpretation of real time systems.

Unit	Topics	Lectures
I	**Introduction** Definition, Typical Real Time Applications: Digital Control, High Level Controls, Signal Processing etc., Release Times, Dead-lines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models for Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency.	**8**
II	**Real Time Scheduling** Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Slack-Time-First (LST) Algorithms, Rate Monotonic Algorithm, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clock Driven Systems.	**8**
III	**Resources Sharing** Effect of Resource Contention and Resource Access Control (RAC), Non-preemptive Critical Sections, Basic Priority-Inheritance and Priority-Ceiling Protocols, Stack Based Priority- Ceiling Protocol, Use of Priority-Ceiling Protocol in Dynamic Priority Systems, Preemption Ceiling Protocol, Access Control in Multiple-Module Resources, Controlling Concurrent Accesses to Data Objects.	**8**
IV	**Real Time Communication** Basic Concepts in Real time Communication, Soft and Hard RT Communication systems, Model of Real Time Communication, Priority- Based Service and Weighted Round-Robin Service Disciplines for Switched Networks, Medium Access Control Protocols for Broadcast Networks, Internet and Resource Reservation Protocols.	**8**
V	**Real Time Operating Systems and Databases** Features of RTOS, Time Services, UNIX as RTOS, POSIX Issues, Characteristic of Temporal data, Temporal Consistency, Con-currency Control, Overview of Commercial Real Time databases.	**8**

Text Books:

1. Real Time Systems – Jane W. S. Liu, Pearson Education Publication.

Reference Books:

1. Real Time Systems – Mall Rajib, Pearson Education
2. Real-Time Systems: Scheduling, Analysis, and Verification – Albert M. K. Cheng, Wiley.

Embedded System
BTOE-605B

Course Objectives: After completion of the course student will be able to:

1. Attain the knowledge of embedded system and its development environment.
2. Gain the knowledge of RTOS based embedded system design and its applications.

Course Outcomes: After completion of the course student will be able to:

1. Understand the basics of embedded system and its structural units.
2. Analyze the embedded system specification and develop software programs.
3. Evaluate the requirements of the programming embedded systems, related software architecture.
4. Understand the RTOS based embedded system design.
5. Understand all the applications of the embedded system and designing issues.

Unit	Topic	Lectures
1	Introduction to Embedded Systems: Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging. Embedded Networking: Embedded Networking: Introduction, I/O Device Ports &	8
2	Buses– Serial Bus communication protocols – RS232 standard – RS422 – RS485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers. Embedded Firmware Development Environment: Embedded Product Development	8
3	Life Cycle objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model. RTOS Based Embedded System Design: Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non preemptive scheduling, Task communication	8
4	shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: Vx Works, чC/OS-II, RT Linux. Embedded System Application Development: Design issues and techniques Case	8
5	Study of Washing Machine- Automotive Application- Smart card System Application.	8

Text Books:

1. Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design" Elsevier, 2006.
2. Michael J. Pont, "Embedded C", Pearson Education , 2007.
3. Steve Heath, "Embedded System Design", Elsevier, 2005.
4. Muhammed Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay, "The 8051.
5. Microcontroller and Embedded Systems", Pearson Education, Second edition, 2007.

Introduction to Mems
BTOE-605C

Course Objectives: After completion of the course student will be able to:

1. Understand the Basic concept of MEMS, Mechanics of Beam and Diaphragm Structures, Air Damping and Electrostatic Actuation.
2. Know the knowledge of Thermal Effects and the Applications of MEMS in RF.

Course Outcomes: After completion of the course student will be able to:

1. Understand the Basic concept of MEMS Fabrication Technologies, Piezoresistance Effect, Piezoelectricity, Piezoresistive Sensor.
2. Explain Mechanics of Beam and Diaphragm Structures.
3. Understand the Basic concept of Air Damping and Basic Equations for Slide-film Air Damping, Couette-flow Model, Stokes-flow Model.
4. Know the concept of Electrostatic Actuation.
5. Understand the applications of MEMS in RF

Unit	Topic	Lectures
1	**Introduction to MEMS:** MEMS Fabrication Technologies, Materials and Substrates for MEMS, Processes for Micromachining, Characteristics, Sensors / Transducers, Piezoresistance Effect, Piezoelectricity, Piezoresistive Sensor.	8
2	**Mechanics of Beam and Diaphragm Structures:** Stress and Strain, Hooke's Law. Stress and Strain of Beam Structures: Stress, Strain in a Bent Beam, Bending Moment and the Moment of Inertia, Displacement of Beam Structures Under Weight, Bending of Cantilever Beam Under Weight.	8
3	**Air Damping:** Drag Effect of a Fluid: Viscosity of a Fluid, Viscous Flow of a Fluid, Drag Force Drag Effect of a Fluid: Viscosity of a Fluid, Viscous Flow of a Fluid, Drag Force Damping, The Effects of Air Damping on Micro-Dynamics. Squeeze-film Air Damping: Reynolds' Equations for Squeeze-film Air Damping, Damping of Perforated Thick Plates. Slide-film Air Damping: Basic Equations for Slide-film Air Damping, Couette-flow Model, Stokes-flow Model.	8
4	**Electrostatic Actuation:** Electrostatic Forces, Normal Force, Tangential Force, Fringe Effects, Electrostatic Driving of Mechanical Actuators: Parallel-plate Actuator, Capacitive sensors. Step and Alternative Voltage Driving: Step Voltage Driving, Negative Spring Effect and Vibration Frequency.	8
5	**Thermal Effects:** Temperature coefficient of resistance, Thermo-electricity, Thermocouples, Thermal and temperature sensors. **Applications of MEMS in RF** MEMS Resonator Design Considerations, One-Port Micromechanical Resonator Modeling Vertical Displacement Two-Port Micro resonator Modeling, Micromechanical Resonator Limitations.	8

Text & Reference Books:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat and V. K. Atre, "Micro and smart systems", Wiley India, 2010.
2. S.M. Sze, "Semiconductor Sensors", John Wiley & Sons Inc., Wiley Interscience Pub.
3. M.J. Usher, "Sensors and Transducers", McMillian Hampshire.
4. RS Muller, Howe, Senturia and Smith, "Micro sensors", IEEE Press.

Object Oriented Programming
BTOE-605D

Course Objectives: After completion of the course student will be able to:

1. Understand the Basic concept of Object Orientation, object identity and Encapsulation.
2. Know the knowledge of Basic Structural Modeling, Object Oriented Analysis and C++ Basics.

Course Outcomes: After completion of the course student will be able to:

1. Understand the Basic concept of Object Orientation, object identity and Encapsulation.
2. Understand the Basic concept of Basic Structural Modeling.
3. Know the knowledge of Object oriented design, Object design.
4. Know the knowledge of C++ Basics.
5. Understand the Basics of object and class in C++.

Unit	Topic	Lectures
1	hiding, polymorphism, generosity, importance of modelling, principles of modelling, object oriented modelling, Introduction to UML, conceptual model of the UML, Architecture.	**8**
2	Basic Structural Modeling: Classes, Relationships, common Mechanisms, and diagrams. Class &Object Diagrams: Terms, concepts, modelling techniques for Class & Object Diagrams. Collaboration Diagrams: Terms, Concepts, depicting a message, polymorphism in collaboration Diagrams, iterated messages, use of self in messages. Sequence Diagrams: Terms, concepts, depicting asynchronous messages with/without priority, call-back mechanism, broadcast messages. Basic Behavioural Modeling: Use cases, Use case Diagrams, Activity Diagrams, State Machine , Process and thread, Event and signals, Time diagram, interaction diagram, Package diagram. Architectural Modeling: Component Deployment, Component diagrams and Deployment diagrams	**8**
3	Object Oriented Analysis: Object oriented design, Object design, Combining three models, Designing algorithms, design optimization, Implementation of control, Adjustment of inheritance, Object representation, Physical packaging, Documenting design considerations. Structured analysis and structured design (SA/SD), Jackson Structured Development (JSD).Mapping object oriented concepts using non-object oriented language, Translating classes into data structures, Passing arguments to methods, Implementing inheritance, associations encapsulation. Object oriented programming style: reusability, extensibility, robustness, programming in the large. Procedural v/s OOP, Object oriented language features. Abstraction and Encapsulation.	**8**
4	C++ Basics : Overview, Program structure, namespace, identifiers, variables, constants, enum, operators, typecasting, control structures C++ Functions : Simple functions, Call and Return by reference, Inline functions, Macro Vs. Inline functions, Overloading of functions, default arguments, friend functions, virtual functions	**8**

Unit	Topic	Lectures
5	Objects and Classes : Basics of object and class in C++, Private and public members, static data and function members, constructors and their types, destructors, operator overloading, type conversion. Inheritance : Concept of Inheritance, types of inheritance: single, multiple, multilevel, hierarchical, hybrid, protected members, overriding, virtual base class Polymorphism : Pointers in C++, Pointes and Objects, this pointer, virtual and pure virtual functions, Implementing polymorphism	8

Text Books:

1. James Rumbaugh et. al, "Object Oriented Modeling and Design", PHI
2. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Language User Guide", Pearson Education
3. Object Oriented Programming with C++, E Balagurusamy, TMH

Reference Books:

1. R. S. Salaria, Mastering Object Oriented Programming with C++, Khanna Publishing House.
2. C++ Programming, Black Book, Steven Holzner, dreamtech.
3. Object Oriented Programming in Turbo C++, Robert Lafore, Galgotia.
4. Object Oriented Programming with ANSI and Turbo C++, Ashok Kamthane, Pearson.
5. The Compete Reference C++, Herbert Schlitz, TMH.
6. C++ and Object Oriented Programming Paradigm, PHI.
7. C++ : How to Program, 9th Edition, Deitel and Deitel, PHI.

Numerical Techniques
BTOE-605E

Course Objective: Students undergoing this course are expected to-

1. Understand about the basics of numerical techniques and its applications to Engineering Problems.

Course Outcomes: After completion of the course student will be able to-

1. Understand about the basics of Ordinary Differential Equations, Separable equations, Equations made separable by change of variables.
2. Retrieve the information content of Power series method.
3. CO3: Apply problem specific Bessel's equation, Bessel Functions to engineering applications.
4. Understand about the basics of matrix, Eigen values and eigen vectors.
5. Analysis of Stage wise Processes by the Calculus of Finite Differences, Countercurrent Liquid-Liquid Extraction.

Unit	Topic	Lectures
1	Ordinary Differential Equations, Separable equations, Equations made separable by change of variables, Homogeneous Equations, Equations with first order and first degree with linear coefficients, Exact equations, Linear equation of first order, Bernoulli's equation, Other degree, Clairaut's equation, Singular solutions, Equations with missing terms, General properties of Linear equations, Linear equations with constant coefficients, Determination of the complementary function, exponential functions, Determination of the particular integral, the Euler equation, Simultaneous Linear Differential equations.	**8**
2	Power series method, theory of the power series method, Legendre's equation, Legendre's Polynomials, Frobenius Method.	**8**
3	Bessel's equation, Bessel Functions Jv(x), Bessel Functions Jv(x) for any $v \geq 0$. Gamma Function, Solution J-v(x) of the Bessel Equation, Backbones of Bessel's Theory, Jv(x) with $v = \pm 1/2, \pm 3/2, \pm 5/2$.	**8**
4	Definition of matrix, Some special definitions and operations involving matrices, Determinants, Theorems on determinants, Inverse of a matrix, Orthogonal and unitary matrix. Orthogonal vectors, System of linear equations, Systems on n equations with n unknowns, Cramer's Rule, Eigen values and eigen vectors.	**8**
5	Analysis of Stage wise Processes by the Calculus of Finite Differences, Countercurrent Liquid- Liquid Extraction, Solution of Difference Equations, Stirred-Tank Reactor System Distillation in a Plate Column, Unsteady-state Operation, Starting a Stirred-tank Reactor, Rate at which a Plate Absorber Approaches Steady State.	**8**

Text & Reference books:

1. Mickley, Reid and Sherwood, "Applied Mathematics in Chemical Engineering", Tata McGraw Hill, New Delhi (1981).
2. E. Kreyszig, "Advanced Engineering Mathematics", 8th edition, John Wiley and Sons (1999).
3. M. R. Spiegel, "Advanced Mathematics for Engineers and Scientists", Schaum Outline Series, McGraw Hill, (1971).
4. Chandrika Prasad, Reena Garg, "Advanced Engineering Mathematics", Khanna Publishing house

GIS & Remote Sensing
BTOE-605F

Course Objective: Students undergoing this course are expected to-

1. Understand about the principles of GIS, Remote Sensing, Spatial Systems, and its applications to Engineering Problems.

Course Outcomes: *After completion of the course student will be able to-*

1. Understand about the principles of Remote Sensing and its advantages and limitations.
2. Retrieve the information content of remotely sensed data.
3. Apply problem specific remote sensing data for engineering applications.
4. Analyze spatial and attribute data for solving spatial problems.
5. Create GIS and cartographic outputs for presentation

Unit	Topic	Lectures
1	Basic component of remote sensing (RS), advantages and limitations of RS, possible use of RS techniques in assessment and monitoring of land and water resources; electromagnetic spectrum, energy interactions in the atmosphere and with the Earth's surface; major atmospheric windows; principal applications of different wavelength regions; typical spectral reflectance curve for vegetation, soil and water, spectral signatures.	**8**
2	Different types of sensors and platforms; contrast ratio and possible causes of low contrast; aerial photography; types of aerial photographs, scale of aerial photographs, planning aerial photography- end lap and side lap; stereoscopic vision, requirements of stereoscopic photographs; air-photo interpretation-interpretation elements;	**8**
3	Photogrammetry- measurements on a single vertical aerial photograph, measurements on a stereo-pair- vertical measurements by the parallax method; ground control for aerial photography; satellite remote sensing, multispectral scanner- whiskbroom and push-broom scanner; different types of resolutions; analysis of digital data- image restoration; image enhancement; information extraction, image classification, unsupervised classification, supervised classification, important consideration in the identification of training areas, vegetation indices.	**8**
4	Microwave remote sensing. GI Sand basic components, different sources of spatial data, basic spatial entities, major components of spatial data, Basic classes of map projections and their properties. .	**8**
5	Methods of data input into GIS, Data editing, spatial data models and structures, Attribute data management, integrating data (map overlay) in GIS, Application of remote sensing and GIS for the management of land and water resources.	**8**

Text & Reference Books:

1. Reddy Anji, M. 2006. Textbook of Remote Sensing and Geographical Information Systems. BS Publications, Hyderabad.
2. Elangovan, K. 2006. GIS Fundamentals Applications and Implementations. New India Publication Agency, New Delhi.

3. George Joseph. 2005. Fundamentals of Remote Sensing. 2nd Edition. Universities Press (India) Private Limited, Hyderabad.
4. Jensen, J.R. 2013. Remote Sensing of the Environment: An Earth Resource Perspective. Pearson Education Limited, UK.
5. Lillesand, T., R.W. Kiefer and J. Chipman. 2015. Remote Sensing and Image Interpretation. 7th Edition, John Wiley and Sons Singapore Pvt. Ltd., Singapore.
6. Sabins, F.F. 2007. Remote Sensing: Principles and Interpretation. Third Edition, Waveland Press Inc., Illinois, USA.

Understanding the Human Being Comprehensively – Human Aspirations and its Fulfillment
BTOE-605G

Course Objectives:

1. To help the students having the clarity about human aspirations, goal, activities and purpose of life.
2. To facilitate the competence to understand the harmony in nature/existence and participation of human being in the nature/existence.
3. To help the students to develop the understanding of human tradition and its various components.

Course Methodology:

1. The methodology of this course is exploration and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. It is free from any dogma or set of do's and don'ts related to values.
3. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated and encouraged to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.
4. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.
5. This self-exploration also enables them to critically evaluate their preconditioning and present beliefs.

Unit	Topic	Lectures
1	**Introduction:** The basic human aspirations and their fulfillment through Right understanding and Resolution; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution.	**8**
2	**Understanding Human being and its expansion:** The domain of right understanding starts from understanding the human being (the knower, the experience and the doer); and extends up to understanding nature/existence – in interconnectedness and co-existence; and finally understanding the role of human being in ence (human conduct).	**8**
3	**Activities of the Self:** Understanding the human being comprehensively is the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Reasons for harmony/contradiction in the self.	**8**
4	**Understanding Co-existence with other orders:** The need and the process of inner evolution (through self-exploration, selfawareness and self-evaluation)- particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).	**8**

Unit	Topic	Lectures
5	**Expansion of harmony from self to entire existence:** Understanding different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavour viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from self to Nature and entire Existence.	**8**

Reference Books:

1. A Foundation Course in Human Values and Profession Ethics (Text Book and Teachers' Manual), R. R. Gaur, R. Sangal, G. P. Bagaria (2010), Excel Books, New Delhi [ISBN 978-8-174-46781-2]
2. Avartansheel Arthshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India
3. Economy of Permanence – (a quest for social order based on non-violence), J. C. Kumarappa (2010), Sarva-Seva-Sangh-Prakashan, Varansi, India
4. Energy and Equity, Ivan Illich (1974), The Trinity Press, Worcester & Harper Collins, USA
5. Ishandi Nau Upnishad, Shankaracharya, Geeta press, Gorakhpur,
6. Manav Vyavahar Darshan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
7. Manaviya Sanvidhan, A. Nagraj, Divya Path Sansthan, Amarkantak, India

CAD/CAM

(BTME701)

Course Objective

The **course** is aimed at giving exposure to and enhancing the knowledge and skills of fresh graduate engineers and engineers involved in the operation use of CNC machines, **CAD**/**CAM** packages and for those who want to provide training to others in this area.

UNIT-I:

Principles of Computer Graphics:

Point plotting, drawing of lines, Bresenham's circle algorithm. Transformation in Graphics: Co-ordinate system used in Graphics and windowing, view port, views. 2D transformations – rotation, scaling, translation, mirror, reflection, shear – homogeneous transformations – concatenation. 3D Transformation – Perspective Projection – Technique (Description of techniques only). Geometric Modelling: Classification of Geometric Modelling – Wire frame, Surface and Solid Modelling, applications – representation of curves and surfaces – Parametric form. Design of curved shapes- Cubic spline – Bezier curve – B-spline – Design of Surfaces - features of Surface Modelling Package – Solid Primitives, CSG. B-rep and description of other modelling techniques like Pure primitive instancing, cell decomposition, spatial occupancy enumeration, Boolean Operations (join, cut, intersection), Creating 3D objects from 2D profiles (extrusion, revolving etc).

UNIT-II:

Graphics standard & Data storage: Standards for computer graphics GKS, PHIGS. Data exchange standards – IGES, STEP – Manipulation of the model - Model storage. Finite Element Modelling: Introduction, Mesh Generation – mesh requirements. Semi-Automatic Methods- Node-based approach, Region based approach, Solid-modelling-based methods. Fully Automatic Methods- Element-based approach, Application, Mesh Refinements using Isoperimetric Finite Elements, Meshing in high gradient areas, Transition Regions. Sub modeling Concept. An overview of modelling software's like PRO-E, CATIA, IDEAS, SOLID EDGE etc.

UNIT-III:

CAM: Scope and applications – NC in CAM – Principal types of CNC machine tools and their construction features – tooling for CNC – ISO designation for tooling – CNC operating system – FANUC, SINUMERIK – LINUMERIK. Programming for CNC machining – coordinate systems – manual part programming – computer assisted part programming – CNC part programming with CAD system. Material handling in CAM environment: Types – AGVS – AS/RS – Swarf handling and disposal of wastes – single and mixed mode assembly lines – quantitative analysis of assembly systems.

UNIT-IV:

Robotics: Classification and specification – drive and controls – sensors - end effectors - grippers- tool handling and work handling – machine vision – robot programming concepts – case studies in assembly. Quality Function Deployment: Process Planning – CAPP – Variant and Generative systems- Concurrent Engineering and Design for Manufacturing. Advanced manufacturing Planning Computer Aided Production Planning and Control – Aggregate production planning and master production schedule – MRP – MRP II – ERP - Capacity planning.

UNIT-V:

Rapid prototyping: Need for rapid prototyping, Basic principles and advantages of RP, General features and classifications of different RP techniques with examples. Introduction to three representative RP techniques: Fusion Deposition Modelling, Laminated Object Manufacturing and Stereo-lithography. Flexible manufacturing cells: Systems – characteristics – economics and technological justification – planning, installation, operation and evaluation issues – role of group technology and JIT in FMS – typical case studies future prospects.

Course Outcome

[1] explain the concepts and underlying theory of modeling and the usage of models in different engineering applications.

[2] Create accurate and precise geometry of complex engineering systems and use the geometric models in different engineering applications.

Books and References:

1. Chris Mcmahon and - CAD/CAM – Principle Practice and Manufacturing Management, Jimmie Browne Addision Wesley England, Second Edition,2000.
2. Dr.Sadhu Singh - Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition,2000.
3. P.Radhakrishnan, - CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.S.Subramanayanand V.Raju.
4. Groover M.P. and - CAD/CAM; Computer Aided Design and Manufacturing, Prentice HallZimmers EW. International, New Delhi, 1992.
5. Ibrahim Zeid - CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd.,Company Ltd., New Delhi, 1992.
6. Mikell P.Groover - Automation , Production Systems and Computer IntegratedManufacturing, Second edition, Prentice Hall of India, 2002.
7. S.Kant Vajpayee - Principles of Computer Integrated Manufacturing, Prentice Hall ofIndia, 1999.
8. David Bed worth - Computer Integrated Design and Manufacturing, TMH, 1998.

CAD/CAM-Lab

(BTME705P)

Course Objective

It is to introduce geometric modeling techniques, data structure **design** and algorithms for solid modeling. It also covers the machining theory, automated CNC machining, and process control.List of Experiments: (Total EIGHT Experiments are to carried out. FOUR Experiments each from

CAD and CAM.)

A. CAD Experiments:

1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
2. Geometric Transformation algorithm experiment for translation/rotation/scaling: Writing and validation of computer program.
3. Design of machine component or other system experiment: Writing and validation of computer program.
4. Understanding and use of any 3-D Modelling Software commands.
5. Pro/E/Idea etc. Experiment: Solid modelling of a machine component.
6. Writing a small program for FEM for 2 spring system and validation of program or using a FEM Package.
7. Root findings or curve fitting experiment: Writing and validation of computer program.
8. Numerical differentiation or numerical integration experiment: Writing and validation of computer program.

B. CAM Experiments:

1. To study the characteristic features of CNC machine.
2. Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine.
3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine.
4. Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine.
5. Experiment on Robot and programs.
6. Experiment on Transfer line/Material handling.
7. Experiment on difference between ordinary and NC machine, study or retrofitting.
8. Experiment on study of system devices such as motors and feedback devices.
9. Experiment on Mechatronics and controls.

Course Outcome

1. Sketch simple figures with title block using AutoCAD software commands.
2. Sketch curves like parabola, spiral and involute of square & circle and draw the orthographic projection of simple solids.
3. Prepare orthographic projection of simple machine parts and draw a plan of residential building.
4. Sketch simple steel truss and sectional views of simple solids.
5. Prepare 2D multi view drawing from 3D model.

Power Plant Engineering

(BTME702A)

Course Objective

To introduce students to different aspects of **power plant engineering**. To familiarize the students to the working of **power plants** based on different fuels. To expose the students to the principles of safety and environmental issues.

UNIT-I:

Introduction:

Power and energy, sources of energy, review of thermodynamic cycles related to power plants,fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units. Power plant economics and selection Effect of plant type on costs, rates, fixed elements, energy elements, customer elements andinvestor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection.

UNIT-II:

Steam power plant:

General layout of steam power plant, Power plant boilers including critical and super criticalboilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coalhandling system, pulverisers and coal burners, combustion system, draft, ash handling system,Dust collection system, Feed water treatment and condenser and cooling towers and coolingponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating andgland leakage. Operation and maintenance of steam power plant, heat balance and efficiency,Site selection of a steam power plant.

UNIT-III:

Diesel power plant:

General layout, Components of Diesel power plant, Performance of diesel power plant, fuelsystem, lubrication system, air intake and admission system, supercharging system, exhaustsystem, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant,Comparative study of diesel power plant with steam power plant. Gas turbine power plant: Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels,cogeneration, auxiliary systems such as fuel, controls and lubrication, operation andmaintenance, Combined cycle power plants, Site selection of gas turbine power plant, Integrated Gasifierbased Combined Cycle (IGCC) systems.

UNIT-IV:

Nuclear power plant:

Layout and subsystems of nuclear power plants, BoilingWater Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, PressurizedHeavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metalcooled reactors, safety measures for nuclear power plants. Hydroelectric and Non-Conventional Power Plant: Hydroelectric power plants, classification, typical layout and components, principles of wind,tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

UNIT-V:

Electrical system:

Generators and generator cooling, transformers and their cooling, bus bar, etc. Energy Saving and Control: Energy, economic and environmental issues, power tariffs, load distribution parameters, loadcurve, capital and operating cost of different power plants, pollution control technologiesincluding waste disposal options for coal and nuclear plants.

Course Outcome

Explain the various subsystems of coal power plant and calculate the efficiency of Rankine cycle.
Discuss the merits & demerits of combined power plants and calculate the efficiency of gas power cycles.
Differentiate pressurized water reactor & boiling water reactor and explain the various waste disposal system in nuclear power plant.
Explain the working principle of various renewable energy power plants.
Explain the different tariff procedures for energy consumption and differentiate fixed and operating costs involved in power production.

Books and References:

1. Power Plant Engineering, by F.T. Morse, Affiliated East-West Press Pvt. Ltd.
2. Power Plant Engineering by Hedge, Pearson India.
3. Power Plant Technology, by Wakil, McGraw Hill.
4. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
5. Steam & Gas Turbines & Power Plant Engineering by R.Yadav, Central Pub.House.
6. Power Plant Engineering by Gupta, PHI India.
7. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
8. Power Plant Engineering. Mahesh Verma, Metropolitan Book Company Pvt. Ltd.

Additive Manufacturing

(BTME702B)

Course Objective

To introduce students the basics of **additive manufacturing**/rapid prototyping and its applications in various fields, reverse engineering techniques. To familiarize students with different processes in rapid prototyping systems.

UNIT-I:
Introduction:
History and Advantages of Additive Manufacturing, Distinction Between Additive Manufacturing and CNC Machining, Types of Additive Manufacturing Technologies, Nomenclature of AM Machines, Direct and Indirect Processes: Prototyping, Manufacturing and Tooling. Layer Manufacturing Processes: Polymerization, Sintering and Melting, Extrusion, Powder-Binder Bonding, Layer Laminate Manufacturing, Other Processes; Aerosol printing and Bio plotter.

UNIT-II:
Development of Additive Manufacturing Technology:
Computer Aided Design Technology, Other Associated Technology, Metal and Hybrid Systems. Generalized Additive Manufacturing Process Chain; The Eight Steps in Additive Manufacturing, Variation from one AM Machine to Another, Metal System, Maintenance of Equipment, Material Handling Issue, Design of AM.

UNIT-III:
Additive Manufacturing Processes:
Vat Photo polymerization, Materials, Reaction Rates, Photo polymerization Process Modelling, Scan Patterns, Powder Bed Fusion Processes; Material, Powder Fusion Mechanism, Process Parameters and Modelling, powder Handling, Extrusion Based System; Basic principles, plotting and Path Control, Bio extrusion, Other Systems, Material Jetting; Materials, Material Processing Fundamentals, Material Jetting Machines, Binder Jetting; Materials, Process Variations, BJ Machines, Sheet lamination Processes; Materials, Ultrasonic Additive Manufacturing, Directed Energy Deposition Processes; General DED Process Description, Material Delivery, DED systems, Process Parameters, Processing- Structure-Properties Relationships, Direct Write Technologies; Ink-Based DW, laser Transfer DW, Thermal Spray DW, Beam Deposition DW, Liquid Phase Direct Deposition, Hybrid Technologies.

UNIT-IV:
Design & Software Issues:
Additive Manufacturing Design and Strategies; Potentials and Resulting Perspectives, AMbased New Strategies, Material Design and Quality Aspects for Additive Manufacturing;Material for AM, Engineering Design Rules for AM. Software Issue for Additive Manufacturing; Introduction, Preparation of CAD Models: TheSTL file, Problem with STL file, STL file Manipulation, Beyond the STL file, AdditionalSoftware to Assist AM.

UNIT-V:
Material Design & Quality Aspects:
Machines for Additive Manufacturing, Printers, Secondary Rapid Prototyping processes, Intellectual Property, Product Development, Commercialization, Trends and Future Directions in Additive Manufacturing, Business Opportunities Applications: Aerospace, Automotive, Manufacturing, Architectural Engineering, Art, Jewellery, Toys, Medical, Biomedical, Dental, Bio-printing, Tissue & Organ Engineering and many others.

Course Outcome

- Describe additive manufacturing and explain its advantages and disadvantages
- Explain the processes used in additive manufacturing for a range of materials and applications
- Understand the role of additive manufacturing in the design process and the implications for design
- Describe the effects of surface finish and microstructural properties on behaviour for components produced using additive manufacturing
- Display an awareness of residual stresses that may occur during additive manufacturing and their effects.

Books and References:

1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, by- Ian Gibson, D Savid W. Rosen, Brent Stucker, Springer.
2. Additive Manufacturing, by- Amit Bandyopadhyay, Susmita Bose, CRC Press.
3. Rapid Prototyping: Principles and Applications, by - Chee Kai Chua, Kah Fai Leong, Chu Sing Lim.

4. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturingby Ian Gibson and David Rosen.
5. Additive Manufacturing of Metals: From Fundamental Technology to Rocket Nozzles, Medical Implants, and Custom Jewelry (Springer Series in Materials Science) by John O Milewski.
6. Additive Manufacturing: Advanced Manufacturing Technology in 3d Print Deposit by SabrieSoloman.
7. Advances in 3D Printing and Additive Manufacturing Technologies by David Ian Wimpenny and Pulak M Pandey.
8. Understanding Additive Manufacturing, by- Andreas Gebhardt, Hanser.

Vehicle Body Engineering and Safety

(BTME702C)

Course Objective

- Classify the vehicles and define basic terms.
- Select appropriate body material.
- Calculate various aerodynamic forces and moments acting on vehicle.
- Calculate load distribution in vehicle body.
- Explain the ergonomics, stability the vehicle.
- Identify the various safety aspects in a given vehicle.
- Identify various sources of noise and methods of noise separation.

UNIT-I:

Introduction:

Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.

UNIT-II:

Safety concepts:

Active safety: driving safety, conditional safety, perceptibility safety, operating safety, passive safety exterior safety, interior safety, deformation behaviour of vehicle body, speed and acceleration characteristics of passenger compartment on impact.

UNIT-III:

Safety equipment's:

Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety.

UNIT-IV:

Collision warning and avoidance:

Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions.

UNIT-V:

Comfort and convenience system:

Steering and mirror adjustment, central locking system, Garage door opening system, tyre pressure control system, rain sensor system, environment information system.

Course Outcome

- Classify the vehicles and define basic terms.
- Select appropriate body material.
- Calculate various aerodynamic forces and moments acting on vehicle.
- Calculate load distribution in vehicle body.
- Explain the ergonomics, stability the vehicle.
- Identify the various safety aspects in a given vehicle.
- Identify various sources of noise and methods of noise separation

Reference Books:

1. Bosch, “Automotive Handbook”, 8th Edition, SAE publication, 2011.
2. Powloski. J., “Vehicle Body Engineering”, Business books limited, London, 1969.
3. Ronald.K.Jurgen, “Automotive Electronics Handbook”, Second Edition, McGraw-Hill Inc., 1999.

Automation and Robotics

(BTME703A)

Course Objective

Students will understand the techniques and applications of Automation and Robotics Programming in an industrial environment. They will learn to design and implement robotic systems and apply what they learned to a career in the Automation and Robotics field.

UNIT- I:

Automation:
Definition, Advantages, goals, types, need, laws and principles of Automation. Elements of Automation. Fluid power and its elements, application of fluid power, Pneumatics vs. Hydraulics, benefit and limitations of pneumatics and hydraulics systems, Role of Robotics in Industrial Automation.

UNIT- II:
Manufacturing Automation:
Classification and type of automatic transfer machines; Automation in part handling and feeding,Analysis of automated flow lines, design of single model, multimodel and mixed modelproduction lines. Programmable Manufacturing Automation CNC machine tools, Machiningcentres, Programmable robots, Robot time estimation in manufacturing operations.

UNIT- III:
Robotics:
Definition, Classification of Robots - Geometric classification and Control classification, Laws of Robotics, Robot Components, Coordinate Systems, Power Source.Robot anatomy, configuration of robots, joint notation schemes, work volume, manipulatorkinematics, position representation, forward and reverse transformations, homogeneoustransformations in robot kinematics, D-H notations, kinematics equations, introduction to robotarm dynamics.

UNIT -IV:
Robot Drives and Power Transmission Systems:
Robot drive mechanisms: Hydraulic / Electric / Pneumatics, servo & stepper motor drives, Mechanical transmission method: Gear transmission, Belt drives, Rollers, chains, Links, Linear to Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Leadscrews, Ball Bearings. Robot end Effectors: Classification of End effectors – active and passive grippers, Tools as end effectors, Drivesystem for grippers. Mechanical, vacuum and magnetic grippers. Gripper force analysis andgripper design.

UNIT- V:
Robot Simulation:
Methods of robot programming, Simulation concept, Off-line programming, advantages of off line programming. Robot Applications: Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Limitation of usage of robots in processing operation. Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference.

Course Outcome

- Describe in detail how industrial robot systems are used, structured and operate,
- Describe in detail the structure and operation of robotic tooling, including actuators, mechanics and sensors,
- Describe other parts of automated manufacturing systems, including process control, component flows, machine safety and personal safety,
- Describe computer-aided production tools and data communication within an industrial robotics network,
- Identify fundamental issues within sustainable industrial development from an automation perspective and be able to exemplify the consequences of these,
- Implement and present a basic automation task with an industrial robot, including pilot study, online and offline programming and evaluation of the results, based on a given specification.

Books and References:

1. An Introduction to Robot Technology, by CoifetChirroza, Kogan Page.
2. Robotics for Engineers, by Y. Koren, McGraw Hill.
3. Robotic: Control, Sensing, Vision and Intelligence, by Fu, McGraw Hill.
4. Introduction to Industrial Robotics, by Nagrajan, Pearson India.
5. Robotics, by J.J. Craig, Addison-Wesley.
6. Industrial Robots, by Groover, McGraw Hill.
7. Robotic Engineering - An Integrated Approach : Richard D. Klafter Thomas A.
8. Robots & Manufacturing Automation, by Asfahl, Wiley.

Modelling and Simulation

(BTME703B)

Course Objective

Students will learn different types of **simulation** techniques. software. **Course** Outline: **Modeling and Simulation** has become an essential tool for engineers for optimum design and the **course aims** to impart an overview of the **modeling and simulation** approaches with emphasis on applications using MATLAB.

UNIT-I:
Bioinformatics objectives and overviews, Interdisciplinary nature of Bioinformatics, Data integration, Data analysis, Major Bioinformatics databases and tools. Metadata: Summary & reference systems, finding new type of data online. Molecular Biology and Bioinformatics: Systems approach in biology, Central dogma of molecular biology, problems in molecular approach and the bioinformatics approach, overview of the bioinformatics applications.

UNIT-II:
Basic chemistry of nucleic acids, Structure of DNA, Structure of RNA, DNA Replication, Transcription-Translation, Genes- the functional elements in DNA, Analyzing DNA, DNA sequencing. Proteins: Amino acids, Protein structure, Secondary, Tertiary and Quaternary structure, Protein folding and function, Nucleic Acid-Protein interaction.

UNIT-III:
Perl Basics, Perl applications for bioinformatics- Bio Perl, Linux Operating System, mounting/unmounting files, tar, gzip / gunzip,telnet, ftp, developing applications on Linux OS,
Understanding andUsing Biological Databases, Overview of Java, CORBA, XML, Webdeployment concepts.

UNIT-IV:
Genome, Genomic sequencing, expressed sequence tags, gene expression, transcription factor binding sites and single nucleotidepolymorphism. Computational representationsof molecular biological data storage techniques: databases (flat,relational and object oriented), and controlled vocabularies, general data retrieval techniques: indices, Booleansearch, fuzzy search and neighbouring, application to biological datawarehouses.

UNIT-V:
Macromolecular structures, chemical compounds, generic variability and its connection to clinical data. Representation of patterns andrelationships: sequence alignment algorithms, regular expressions, hierarchies and graphical models, Phylogenetics. BLAST.

Course Outcome
1. Grasping **modeling** concepts using mean value analysis with some information technology applications.
2. Grasping how to build appropriate **simulation models** together with their parameterization and the analysis of simulator output data.

Books and References:
1. D E Krane & M L Raymer," Fundamental concepts of Bioinformatics", Perason Education.
2. Rastogi, Mendiratta, Rastogi, "Bioinformatics Methods & applications, Genomics, Proteomics & Drug Discovery" PHI, New Delhi.
3. Shubha Gopal et.al. "Bioinformatics: with fundamentals of genomics and proteomics", Mc Graw Hill.
4. O'Reilly, "Developing Bio informatics computer skills", CBS.

5. Simulation Model Design& execution by Fishwich, Prentice Hall, 1995.
6. Discrete event system simulation by Banks, Carson, Nelson and Nicol.
7. Averill M. Law, W. David Kelton, “Simulation Modelling and Analysis”,TMH.
8. Forsdyke, “Evolutionary Bioinformatics”, Springer.

Computational Fluid Dynamics

(BTME703C)

Course Objective:
To introduce the student to widely used techniques in the numerical solution of **fluid** equations, issues that arise in the solution of such equations, and modern trends in **CFD**.
Emphasis will be on '**learning** by doing', as students will work on programming projects for assignments.

UNIT- I:
Governing Equations and Boundary Conditions:
Basics of computational fluid dynamics. Governing equations of fluid dynamics. Continuity, Momentum and Energy equations. Chemical species transport. Physical boundary conditions, Time averaged equations for Turbulent Flow. Turbulent–Kinetic Energy Equations Mathematical behaviour of PDEs onCFD. Elliptic, Parabolic and Hyperbolic equations.

UNIT -II:
Finite Difference Method:
Derivation of finite difference equations. Simple Methods. General Methods for first and second order accuracy, solution methods for finite difference equations. Elliptic equations. Iterative solution Methods. Parabolic equations. Explicit and Implicit schemes. Example problems onelliptic and parabolic equations.

UNIT- III:
Finite Volume Method (FVM) for Diffusion:
Finite volume formulation for steady state One, Two- and Three-dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank. Nicolson and fullyimplicit schemes.

UNIT -IV:
Finite Volume Method for Convection Diffusion:
Steady one-dimensional convection and diffusion. Central, upwind differencing schemespropertiesofdiscretization schemes. Conservativeness, Boundedness, Transportive, Hybrid,Power-law, QUICKSchemes.

UNIT- V:
Calculation Flow Field by FVM:
Representation of the pressure gradient term and continuity equation. Staggered grid. Momentumequations. Pressure and Velocity corrections; Pressure Correction equation, SIMPLE algorithmand itsvariants. Turbulence models, mixing length model, Two equation (k-Є) models. High andlow Reynoldsnumber models.

Course Outcome
The students will learn to assess the quality of numerical results and the efficiency of numerical methods for basic **fluid flow** model problems. Knowledge: After completion of this **course**, the student will have knowledge on: - Classification of the basic equations of **fluid dynamics**.

Books and References:
1. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, by Versteeg, Pearson,
India.
2. Numerical Heat Transfer and Fluid Flow, by Patankar, Tayers&Francis.
3. Computational Heat Transfer, by Jaluriaans Torrance, CRC Press.
4. Computational Fluid Dynamics, by Anderson, Mc Graw Hill.

5. Computational Fluid Dynamics, by Chung, Cambridge University Press.
6. Computer Simulation of flow and heat transfer, by Ghoshdastidar McGraw Hill.
7. Introduction to Computational Fluid Dynamics, by Prodip Niyogi. Pearson India.
8. Computational Fluid Flow and Heat Transfer, by Muralidhar and Sundararajan, Narosa Publishing House.
9. Computational Fluid Dynamics: Principles and Applications, by Blazek, Elsevier Science & Technology.

Automotive Transmission

(BTME703D)

Course Objective

The **objective** of the **course** is to provide comprehensive knowledge on various **transmission** systems and their components such as gear boxes and hydraulic drives. It also imparts understanding of various **automatic transmission** systems and their applications along with hydrostatic and electric drives.

UNIT-I:

Clutch and gear box:

Requirement of transmission system, Different types of clutches, principle & Construction of Single plate coil spring and Diaphragm spring clutches., Need and Objectives of Gear box. Construction and operation of Sliding mesh, Constant mesh and Synchromesh gearboxes. – Determination of gear ratios for vehicles. Performance characteristics in different speeds. Problems on performance of automobile such as Resistance to motion, Tractive effort, Engine speed & Power and acceleration.

UNIT-II:

Hydrodynamic transmission:

Fluid coupling-Principle-Constructional details. Torque capacity. Performance characteristics. Reduction of drag torque in fluid coupling. Torque converter Principle constructional details, performance characteristics. Multistage torque converters and Poly phase torque converters.

UNIT-III:

Epicyclic gearboxes used in automatic transmission:

Principle of Planetary gear trains – Wilson Gear box, Octal electromagnetic transmission- Hydraulic control system for Automatic Transmission.

UNIT-IV:

Automatic transmission applications:

Need for automatic transmission, Four speed longitudinally mounted automatic transmission – Chevrolet "Turboglide" Transmission, Continuously Variable Transmission (CVT) – Types – Operations of a typical CVT.

UNIT-V:

Hydrostatic and electric drive:

Hydrostatic drive; Various types of hydrostatic systems – Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, construction and working of typical Janny hydrostatic drive. Electric drive-types- Principle of early and modified Ward Leonard Control system-Advantages & limitations.

Course Outcome

- Perform automatic drive train inspection, maintenance, diagnosis and repairs.
- Access and utilize repair information in a rapidly changing technology.
- Develop and implement strategies and processes to solve automatic drive train repair problems.
- Perform automatic drive train repair to professional and ethical standards.
- Communicate professionally with employers, customers and co-workers using industry standard language and following industry standard protocols.

Books and References:

1. Heldt, P.M., "Torque converters", Chilton Book Co., 1962.
2. Newton and Steeds, "Motor vehicles", Illiffe Publishers, 1985.

3. Devaradjane. Dr. G., Kumaresan. Dr. M., “Automobile Engineering”, AMKPublishers, 2013.
4. Hydrostatic transmissions for vehicle applications, I Mech E Conference, 1981-88.
5. Crouse,W.H., Anglin,D.L.,” Automotive Transmission and Power Trainsconstruction”, McGraw Hill, 1976.
6. Heinz Heisler, “Advance vehicle Technology”, Butterworth-Heinemann, 2002.

Lean Manufacturing

(BTME703E)

Course Objective

To understand **lean management** principles & provides an understanding of factors that contribute to organizational wastes, examining ways to eliminate wastes, & developing & implementing an improved organizational processes, for significant impact to the company's bottom line.

UNIT-I:
Overview:
SEVEN forms of waste and their description; Historical evolution of lean manufacturing; Global competition, Customer requirements, Requirements of other stake holders. Meaning of Lean Manufacturing System (LMS), Meaning of Value and waste, Need for LMS, Symptoms of underperforming organizations, Meeting the customer requirement, Elements of LMS.

UNIT-II:
Primary tools used in LMS:
Meaning and Purpose of 5S Work place organization, 5S process – Sort, set in order, Shine, Standardize, Sustain, implementing 5S. Meaning and purpose of TPM, Pillars of TPM, Conditions for TPM success, TPM implementation process, Overall Equipment Effectiveness and problems on computation of OEE.

UNIT-III:
Process Mapping and Value Stream Mapping (VSM) – Need for process maps, advantages, types and its construction, steps in preparing VSM. Concept of work Cell and its design, Line balancing algorithms and problems.

UNIT-IV:
Secondary tools used in LMS:
Cause and effect diagram, Pareto chart, Radar chart, Poke Yoke, Kanban, Automation, SMED, Standardized fixture, DFMA, JIT. Visual workplace, problems on Pareto analysis and computation of number of kanbans.

UNIT-V:
LMS Rules:
Stability, Management, Standardized work, Pull system, Continuous improvement. Lean Implementation: Training, selecting the projects, preparing project charter, project implementation, Project review. Implementing LMS for higher productivity: Operator, process, machinery and equipment, workplace organization, Inventory, LMS Design Process.

Course Outcome

Explain the approaches to, concepts, and theories of Lean Manufacturing, including key aspects of Just in Time and Six Sigma.
Apply World Class Manufacturing (WCM) techniques to effect continuous improvement.
Apply Analytical Troubleshooting (ATS) techniques to technical problem solving and decision making.
Explain people management issues and discuss how they can be addressed.

Books and References:

1. N. Goplakrishnan, Simplifed Lean Manufacture, PHI, 2010.
2. Pascal Dennis, Lean Production Simplified, Productivity Press, 2007.
3. Creating a Kaizen Culture (2013) by Jon Miller, Mike Wroblewski and Jaime Villafuerte.
4. The Lean Turnaround (2012) by Art Byrne.
5. The Toyota Production System: Beyond Large-Scale Production (1988) by Taiichi Ohno.
6. Out of the Crisis (1986) by W. Edwards Deming.
7. Jeffrey Liker, The Toyota Way, Tata McGraw-Hill, 2004

Digital and Social Media Marketing
(BTMEOE704A)

COURSE OBJECTIVE

- Introduce current and core practices of Digital and Social Media Marketing that will allow learners to analyses, plan, execute and evaluate a digital marketing strategy.
- Introduce core tools currently used in Digital and Social Media Marketing that will allow learners to analyses, plan, execute and evaluate a digital marketing strategy.
- Develop an understanding of Search Engine Optimization (SEO), Social Media Optimization, Affiliate and other relevant communication channels for engagement of digital communities.

COURSE OUTCOMES

Through successful completion of this course, students will:

- Understand what social media is, the various channels through which it operates, and its role in marketing strategy.
- Use principles of consumer and social psychology to develop social media content and campaigns that engage consumers.
- Draw on knowledge about word-of-mouth marketing to develop effective approaches for propagating ideas, messages, products, and behaviors across social networks.
- Measure the impact of a social media campaign in terms of a specific marketing objective

UNIT-I

Introduction to Digital Marketing: The new digital world - trends that are driving shifts from traditional marketing practices to digital marketing practices, the modern digital consumer and new consumer's digital journey. Marketing strategies for the digital world-latest practices. **[8]**

UNIT-II

Social Media Marketing -Introduction to Blogging, Create a blog post for your project. Include headline, imagery, links and post, Content Planning and writing. Introduction to Face book, Twitter, Google +, LinkedIn, YouTube, Instagram and Pinterest; their channel advertising and campaigns **[8]**

UNIT-III

Acquiring & Engaging Users through Digital Channels: Understanding the relationship between content and branding and its impact on sales, search engine marketing, mobile marketing, video marketing, and social-media marketing. Marketing gamification, Online campaign management; using marketing analytic tools to segment, target and position; overview of search engine optimization (SEO). **[8]**

UNIT-IV

Designing Organization for Digital Success: Digital transformation, digital leadership principles, online P.R. and reputation management. ROI of digital strategies, how digital marketing is adding value to business, and evaluating cost effectiveness of digital strategies **[8]**

UNIT-V

Digital Innovation and Trends: The contemporary digital revolution, digital transformation framework; security and privatization issues with digital marketing Understanding trends in digital marketing – Indian and global context, online communities and co-creation. **[8]**

Text books:

1. Moutsy Maiti: Internet Mareting, Oxford University Press India
2. Vandana, Ahuja; Digital Marketing, Oxford University Press India (November, 2015).
3. Eric Greenberg, and Kates, Alexander; Strategic Digital Marketing: Top Digital Experts Share the Formula for Tangible Returns on Your Marketing Investment; McGraw-Hill Professional (October, 2013).
4. Ryan, Damian; Understanding Digital Marketing: marketing strategies for engaging the digital generation; Kogan Page (3rd Edition, 2014).
5. Tracy L. Tuten & Michael R. Solomon: Social Media Marketing (Sage Publication)

Idea to Business Model

(BTMEOE704B)

Course Objectives:

- This course can motivate students to have an overall idea how to start and sustain a businessenterprise.
- The students will learn basics of choosing an idea of a business model.
- The core areas of choosing a business model are encompassed with Entrepreneurship development, PPC & communication system. The students will thus develop basic competencies how to run a business enterprise.

Course Outcome:

- Examine the challenges associated with defining the concepts of entrepreneur and entrepreneurship
- Discuss how the evolution of entrepreneurship thought has influenced how we view the concept of entrepreneurship today
- Discuss how the list of basic questions in entrepreneurship research can be expanded to include research inquiries that are important in today's world
- Discuss how the concepts of entrepreneurial uniqueness, entrepreneurial personality traits, and entrepreneurial cognitions can help society improve its support for entrepreneurship
- Apply the general venturing script to the study of entrepreneurship

Unit-I Introduction

Search for a business idea- How to choose an idea- Product idea- selection of product- The adoption process- Product innovation- Production , planning and development strategy- New product idea. **[8]**

Unit-II Introduction to Entrepreneurship - Meaning and concept of entrepreneurship- Difference between Entrepreneurship & wage employment - Functions of an Entrepreneur.- Entrepreneur vs Managerrole of entrepreneurship in economic development – Barriers to entrepreneurship. **[8]**

Unit-III The Entrepreneur - types of entrepreneurs- Competencies required to become an entrepreneur - Creative and Design Thinking, the entrepreneurial decision process- The process of Entrepreneurial development prog (EDP)- Evaluation of EDP - Entrepreneur development training. **[8]**

Unit-IV Production system- Design of production system- Types of production system- Production, planning & control (PPC) - Steps of PPC. **[8]**

Unit-V Communication- Importance of communication system - barriers to communication - listening to people- the power of talk - personal selling - risk taking & resilience - negotiation. **[8]**

Text Books:

1. Entrepreneurship Development- Sangeeta Sharma, Kindle edition
2. Production & operations Management- Kanishka Bedi,

3. Marketing Management- Philip Kotler.
4. The Business Model Book: Design, build and adapt business ideas that drive business growth: Adam Bock , Gerard George

Machine Learning
(BTMEOE704C)

Course Objectives:

1. To introduce students to the basic concepts and techniques of Machine Learning.
2. To become familiar with regression methods, classification methods, clustering methods.
3. To become familiar with Dimensionality reduction Techniques.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Gain knowledge about basic concepts of Machine Learning
2. Identify machine learning techniques suitable for a given problem
3. Solve the problems using various machine learning techniques
4. Apply Dimensionality reduction techniques.
5. Design application using machine learning techniques.

UNIT-I

INTRODUCTION – Well defined learning problems, Designing a Learning System, Issues in Machine Learning;

THE CONCEPT LEARNING TASK - General-to-specific ordering of hypotheses, Find-S, List then eliminate algorithm, Candidate elimination algorithm, Inductive bias. **[8]**

UNIT-II

DECISION TREE LEARNING - Decision tree learning algorithm-Inductive bias- Issues in Decision tree learning;

ARTIFICIAL NEURAL NETWORKS – Perceptrons, Gradient descent and the Delta rule, Adaline, Multilayer networks, Derivation of back propagation rule Back propagation Algorithm Convergence, Generalization. **[8]**

UNIT-III

Evaluating Hypotheses: Estimating Hypotheses Accuracy, Basics of sampling Theory, Comparing Learning Algorithms; Bayesian Learning: Bayes theorem, Concept learning, Bayes Optimal Classifier, Naive Bayes classifier, Bayesian belief networks, EM algorithm. **[8]**

UNIT-IV

Computational Learning Theory: Sample Complexity for Finite Hypothesis spaces, Sample Complexity for Infinite Hypothesis spaces, The Mistake Bound Model of Learning; INSTANCE-**BASED LEARNING** – k-Nearest Neighbor Learning, Locally Weighted Regression, Radial basis function networks, Case based learning. **[8]**

UNIT-V

Genetic Algorithms: an illustrative example, Hypothesis space search, Genetic Programming, Models of Evolution and Learning; Learning first order rules sequential covering algorithms-General to specific beam search-FOIL;

REINFORCEMENT LEARNING - The Learning Task, Q Learning. **[8]**

Text books:

1. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Ethem Alpaydin, ―Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
3. Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.
4. Bishop, C., Pattern Recognition and Machine Learning. Berlin: Springer- Verlag.

Renewable Energy Resources
(BTMEOE704D)

Course Objectives:

1. Understand the various forms of conventional energy resources.
2. Learn the present energy scenario and the need for energy conservation
3. Explain the concept of various forms of renewable energy
4. Outline division aspects and utilization of renewable energy sources for both domestics and industrial application
5. Analyse the environmental aspects of renewable energy resources.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Describe the environmental aspects of non-conventional energy resources. In Comparison with various conventional energy systems, their prospects and limitations.
2. Know the need of renewable energy resources, historical and latest developments.
3. Describe the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, power generation, drying, cooking etc.
4. Appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.
5. Understand the concept of Biomass energy resources and their classification, types of biogas Plants-applications
6. Compare Solar, Wind and bio energy systems, their prospects, Advantages and limitations.
7. Acquire the knowledge of fuel cells, wave power, tidal power and geothermal principles and applications.

UNIT-I

Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits.

Solar Cells: Theory of solar cells. Solar cell materials , solar cellarray, solarcell power plant, limitations. **[8]**

UNIT-II

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal powerplants, thermal energy storage for solar heating and cooling, limitations. **[8]**

UNIT-III

Geothermal Energy: Resources of geothermal energy, thermodynamics of geothermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. Cells: Principle of working of various types of fuel cells and their working, performance and limitations. **[8]**

UNIT-IV

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems. **[8]**

UNIT-V

Bio-mass: Availability of bio-mass and its conversion theory. Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance a nd limitations.

Wave and Tidal Wave : Principle of working, performance and limitations. Waste Recycling Plants.

[8]

Text books:

1. Raja etal, "Introduction to Non-Conventional Energy Resources" Scitech Publications.
2. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
3. M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional" BSP Publications,2006.
4. D.S. Chauhan,"Non-conventional Energy Resources" New Age International.
5. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.
6. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.
7. Godfrey Boyle," Renewable Energy Power For A Sustainable Future", Oxford University Press.

Operations Research

(BTMEOE704E)

Course Objectives:
The course aims at building capabilities in the students for analyzing different situations in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Identify and develop operational research models from the verbal description of the real system.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.
4. Develop a report that describes the model and the solving technique, analyze the results and propose recommendations in language understandable to the decision-making processes in Management Engineering.

UNIT-I
Introduction: Definition and scope of operations research (OR), OR model, solving the OR model, art of modelling, phases of OR study. Linear Programming: Two variable Linear Programming model and Graphical method of solution, Simplex method, Dual Simplex method, special cases of Linear Programming, duality, sensitivity analysis. **[8]**

UNIT-II
Transportation Problems: Types of transportation problems, mathematical models , transportation algorithms, Assignment: Allocation and assignment problems and models, processing of job through machines. **[8]**

UNIT-III
Network Techniques: Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem. Project Management: Phases of project management, guidelines for network construction, CPM and PERT. **[8]**

UNIT-IV
Theory of Games : Rectangular games, Minimax theorem, graphical solution of 2x nor mx2 games, game with mixed strategies, reduction to linear programming model. Quality Systems: Elements of Queuing model, generalized poisson queing model, single server models. **[8]**

UNIT-V
Inventory Control: Models of inventory, operation of inventory system, quantity discount. Replacement: Replacement models: Equipments that deteriorate with time, equipments that fail with time.

[8]

Text books:

1. Wayne L. Winston,"Operations Research" Thomson Learning, 2003.
2. Hamdy H. Taha, "Operations Research-An Introduction" Pearson Education, 2003.
3. R. Panneer Seevam, "Operations Research" PHI Learning, 2008.
4. V.K.Khanna, "Total Quality Management" New Age International, 2008.

Value Relationship & Ethical Human Conduct –For A Happy & Harmonious Society (BTMEOE704F)

Course Objectives:

1. To help the students to understand the importance and types of relationship with expressions.
2. To develop the competence to think about the conceptual framework of undivided society as well as universal human order.
3. To help the students to develop the exposure for transition from current state to the undivided society and universal human order.

Course Methodology:

1. The methodology of this course is exploration and thus universally adaptable. It involves a systematic and rational study of the human being vis-a-vis the rest of existence.
2. It is free from any dogma or set of do's and don'ts related to values.
3. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated and encouraged to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.
4. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.
5. This self-exploration also enables them to critically evaluate their preconditioning and present beliefs. Introduction to the course: Basic aspiration of a Human Being and program for its fulfilment, Need for family and relationship for a Human Being, Humanhuman relationship and role of behavior in its fulfillment, Human-rest of Nature

UNIT-I

Relationship and role of work in its fulfilment, Comprehensive Human Goal, Need for Undivided Society, Need for Universal Human Order, an appraisal of the Current State, Appraisal of Efforts in this Direction in Human History.

UNIT-II

Understanding Human-Human Relationship & its fulfilment: Recognition of Human-Human Relationship, Recognition of feelings in relationship, Established Values and Expressed Values in Relationship, interrelatedness of feelings and their fulfilment, Expression of feelings, Types of relationship and their purpose, mutual evaluation in relationship, Meaning of justice in relationship, Justice leading to culture, civilization and Human Conduct.

UNIT-III

Justice from family to world family order: Undivided Society as continuity and expanse of Justice in behaviour – family to world family order, continuity of culture and civilization, Universal Order on the basis of Undivided Society, Conceptual Framework for Universal human order, Universal Human Order as continuity and expanse of order in living: from family order to world family order, a conceptual framework for universal human order.

UNIT-IV

Program for Ensuring Undivided Society and Universal Human Order: Education –Sanskar, Health – Sanyam, Production-work, Exchange – storage, Justice-preservation.

UNIT-V

Human Tradition: Scope and Steps of Universal Human Order, Human Tradition (Ex. Family order to world family order), Steps for transition from the current state, Possibilities of participation of students in this direction, Present efforts in this direction, Sum up.

Text books:

1. A Foundation Course in Human Values and Profession Ethics (Text Book and Teachers' Manual),
1. R. R. Gaur, R. Asthana, G. P. Bagaria (2010), Excel Books, New Delhi.
2. Avartansheel Arthshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
3. An Appeal by the Dalai Lama to the World: Ethics Are More Important Than Religion, Dalai Lama XIV, 2015.
4. Economy of Permanence – (a quest for social order based on non-violence), J. C. Kumarappa (2010), Sarva-Seva-Sangh-Prakashan, Varansi, India.
5. Energy and Equity, Ivan Illich (1974), The Trinity Press, Worcester & Harper Collins, USA.
6. Human Society, Kingsley Davis, 1949.
7. Hind Swaraj or, Indian home rule Mohandas K. Gandhi, 1909.
8. Integral Humanism, Deendayal Upadhyaya, 1965.
9. Lohiya Ke Vichar, Lok Bharti , Rammanohar Lohiya, 2008.
10. Manav Vyavahar Darshan, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
11. Manaviya Sanvidhan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
12. Samadhanatmak Bhautikvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India
13. Small Is Beautiful: A Study of Economics as if People Mattered, E. F. Schumacher,1973, Blond & Briggs, UK.
14. Slow is Beautiful, Cecile Andrews (http://www.newsociety.com/Books/S/Slow-is- Beautiful)
15. Sociology Themes and Perspectives, Harper Collins; EIGHT edition (2014), Martin Holborn and Peter Langley, 1980.
16. Samagra kranti: Jaya Prakash Narayan's philosophy of social change, Siddharth Publications Renu Sinha, 1996.
17. Science & Humanism – towards a unified worldview, P. L. Dhar & R. R. Gaur (1990), Commonwealth Publishers, New Delhi
18. Vyavaharvadi Samajshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
19. Vyavahatmak Janvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
20. The Communist Manifesto, Karl Marx, 1848.
21. Toward a True Kinship of Faiths: How the World's Religions Can Come Together Dalai Lama XIV, 2011

Reference Videos.

1. Kin school (30 minutes)
2. Technology (Solar City etc.).
3. Natural Farming.
4. Economics of Happiness (1h 8m).

Mini Project
(BTME706P)

Students will be asked to work upon minimum one topic during the semester.

They will submit the report of each topic containing following information (as per need of topic) like: introduction, general information, usage/application (if any) detailed description of work/process, relevant diagrams, drawings & tabulation (if any), observation and results (as applicable) or any other relevant information as per topic.

Internship Assessment

(BTME707P)

Project Management & Entrepreneurship

(BTME801)

Unit	Topics	Lectures
I	**Entrepreneurship:** Entrepreneurship: need, scope , Entrepreneurial competencies & traits, Factors affecting entrepreneurial development, Entrepreneurial motivation (Mc Clellend's Achievement motivation theory), conceptual model of entrepreneurship , entrepreneur vs. intrapreneur; Classification of entrepreneurs; Entrepreneurial Development Programmes	8
II	**Entrepreneurial Idea and Innovation:** Introduction to Innovation, Entrepreneurial Idea Generation and Identifying Business Opportunities, Management skills for Entrepreneurs and managing for Value Creation, Creating and Sustaining Enterprising Model & Organizational Effectiveness	8
III	**Project Management:** Project management: meaning, scope & importance, role of project manager; project life-cycle Project appraisal: Preparation of a real time project feasibility report containing Technical appraisal,; Environmental appraisal, Market appraisal (including market survey for forecasting future demand and sales) and Managerial appraisal.	8
IV	**Project Financing:** Project cost estimation & working capital requirements, sources of funds, capital budgeting, Risk & uncertainty in project evaluation , preparation of projected financial statements viz. Projected balance sheet, projected income statement, projected funds & cash flow statements, Preparation of detailed project report, Project finance.	8
V	**Social Entrepreneurship:** Social Sector Perspectives and Social Entrepreneurship, Social Entrepreneurship Opportunities and Successful Models, Social Innovations and Sustainability, Marketing Management for Social Ventures, Risk Management in Social Enterprises, Legal Framework for Social Ventures.	8

Text Book:

1. Innovation and Entrepreneurship by Drucker, P.F.; Harper and Row
2. Business, Entrepreneurship and Management: Rao, V.S.P. ;Vikas
3. Entrepreneurship: Roy Rajeev; OUP.
4. Text Book of Project Management: Gopalkrishnan, P. and Ramamoorthy, V.E.; McMillan
5. Project Management for Engineering, Business and Technology: Nicholas, J.M., and Steyn, H.; PHI
6. Project Management: The Managerial Process: Gray, C.F., Larson, E.W. and Desai, G.V.; MGH

Subject Code: BTME802A	Flexible Manufacturing	L T P : 3 0 0	Credits: 3

Course Outcomes: The students will be able to		Blooms Taxonomy
CO-1	Understand the manufacturing systems, flexibility, components of FMS	K2
CO-2	Understand production, planning, scheduling and simulation of FMS	K2
CO-3	Understand concepts of group technology and economics issues in the application of FMS	K2
CO-4	Understand the application of FMS in various operations & involvement of AI in flexible manufacturing system.	K2
CO-5	Apply the concepts of scheduling and simulation in FMS	K3

UNIT-I: Understanding of FMS

Introduction To FMS, Evolution of Manufacturing Systems, objective and Need, Benefits, Components, Types of Flexibility, Merits, Demerits and Applications of Flexibility.

Composition of FMS, CNC machines, robots, automatic storage and retrieval, automatic material handling, computerized control, Hierarchy of Computer Control ,Computer Control of Work Centre and Assembly Lines, FMS Supervisory Computer Control.

UNIT-II: Planning, scheduling and control of flexible manufacturing systems: Process planning, machine loading, cycle time, machine output vs cycle time, methods to reduce cycle time, machine balancing.

Scheduling, data requirement for scheduling, mater production scheduling, Gantt charts, scheduling rules, scheduling in FMS, Single Product, Single Batch, N–Batch Scheduling Problem, Knowledge Based Scheduling System.

Dispatching, Dispatch activities.

UNIT-III: **FMS simulation and data base**
Application of Simulation, Model of FMS, Simulation Software, Limitation, Manufacturing Data Systems, Data Flow, FMS Database Systems, Planning For FMS Database.

Design of FMS: Performance Evaluation of FMS, Analytical model and Simulation model of FMS.

UNIT-IV: Group technology and justification of FMS

Introduction, Matrix Formulation, Mathematical Programming Formulation, Graph Formulation, Knowledge Based System for Group Technology, Economic Justification Of FMS, Implementation issues and maintenance of FMS, Application of Possibility Distributions in FMS Systems Justification.

UNIT-V: Applications of FMS and factory of the future

FMS Application in Machining, Sheet Metal Fabrication, Prismatic Component Production, Aerospace Application, FMS Development Towards Factories of The Future, Artificial Intelligence and Expert Systems in FMS, Design Philosophy and Characteristics for Future, case studies.

Books and References:

1. Jha, N.K. "Handbook of Flexible Manufacturing Systems", Academic Press Inc., 1991.
2. Radhakrishnan P. And Subramanyan S., "CAD/CAM/CIM", Wiley Eastern Ltd., New Age International Ltd., 1994.
3. Raouf, A. And Ben-Daya, M., Editors, "Flexible Manufacturing Systems: Recent Development", Elsevier Science, 1995.
4. GrooverM.P., "Automation, Production Systems And Computer Integrated Manufacturing", Prentice Hall Of India Pvt., New Delhi, 1996.
5. Reza A Maleki "Flexible Manufacturing system" Prentice Hall of Inc New Jersey, 1991
6. TaiichiOhno, "Toyota Production System: Beyond Large-Scale Production", Productivity Press (India) Pvt. Ltd. 1992.

Subject Code: BTME802B	Advance Manufacturing Science	L T P : 3 0 0	Credits: 3

Course Outcomes: The students will be able to		Blooms Taxonomy
CO-1	Understand the principles of material removal mechanism of advanced machining processes.	K2
CO-2	Understand the basic concept of advance metal forming processes.	K2
CO-3	Understand the basic concept of advance casting processes.	K2
CO-4	Understand the basic concepts of advance welding process.	K2
CO-5	Understand various hybrid modern manufacturing methods.	K2

UNIT-1

Introduction **(3 Hours)**

Types of advanced manufacturing processes, Evolution, need, and classification of advanced machining processes.

Advanced Machining Processes **(5 Hours)**

Introduction Need & benefits, application and working principle, Advantages & Disadvantages of Abrasive jet machining (AJM) Water jet machining (WJM) Abrasive water jet machining (AWJM), Advance abrasive finishing process, Abrasive Flow Finishing, Magnetic Field Assisted Abrasive Finishing, Magneto Rheological Finishing.

UNIT-2

Advanced Machining Processes continued... **(7 Hours)**

Process principle, Mechanism of material removal, Process Parameters, Process Capabilities, and Applications of Electrochemical machining (ECM), Electro discharge machining (EDM), Electron beam machining (EBM), Laser beam machining (LBM) processes.

UNIT-3

Advanced Metal Forming Processes **(6 Hours)**

Details of high energy rate forming (HERF) process, Electro-magnetic forming, explosive forming, Electro-hydraulic forming, Stretch forming and Contour roll forming.

UNIT-4

Advanced Casting Processes **(7 Hours)**

Metal mould casting, Continuous casting, Squeeze casting, Vacuummould casting, Evaporative pattern casting, Ceramic shell casting.

Advance Welding Processes: Magnetic arc welding, Friction welding, Explosive welding, Ultrasonic welding, Laser welding, Electron beam welding

UNIT-5 **(8Hours)**

Derived and Hybrid Modern manufacturing Methods: Introduction of process like rotary ultrasonic machining , electro stream drilling, shape tube electro machining, wire electro discharge machining, electro chemical grinding, electro chemical honing, electro chemical deburring and electro chemical spark machining.

Reference Books:-

1. "Materials and Processes in Manufacturing" (8th Edition), E.P. De Garmo, J. T Black, R.A.Kohser, Prentice Hall of India, New Delhi (ISBN 0-02-978760).

2. "Manufacturing Science" A. Ghosh, and A.K. Mallik, Affiliated East-West Press Pvt. Ltd. New Delhi.

3. "Nontraditional Manufacturing Processes", G.F.Benedict, Marcel Dekker, Inc. New York (ISBN 0-8247-7352-7).

4. H. Abdel and G. El-Hofy, Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, 1 st edition, McGraw-Hill Professional, 2005. ISBN: 978- 0071453349.

Subject Code: BTME802C	Hybrid Vehicle Propulsion	L T P : 3 0 0	Credits: 3

The students will be able to		Blooms Taxonomy
CO-1	Understand the basics of the hybrid electric vehicles and it's types.	K2
CO-2	Understand the types of drive trains used in hybrid vehicles	K2
CO-3	Understand the propulsion units used in Hybrid Vehicles and their efficiency.	K2
CO-4	Understand the requirements and devices of energy storage used in hybrid vehicles.	K2
CO-5	Understand the concept of downsizing of IC engines in case of hybrid vehicles.	K2
CO-6	Understand the principles of energy management and issues related to these strategies.	K2

UNIT I

Introduction to Hybrid Electric Vehicles: **[L-4 Hours]**

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Conventional Vehicles: **[L-4 Hours]**

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

UNIT II

Hybrid Electric Drive-trains: **[L-4 Hours]**

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Electric Drive-trains: **[L-4 Hours]**

Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT III

Electric Propulsion unit: **[L-10 Hours]**

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV

Energy Storage: **[L-5 Hours]**

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Sizing the drive system: **[L-4 Hours]**

Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

UNIT V

Energy Management Strategies: **[L-8 Hours]**

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Text Books:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press , 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press , 2004.

Reference Books:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley , 2003.
2. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons Ltd., 2011.

Subject Code: BTMEOE803A	FILTER DESIGN	3L:0T:0P	3 Credits

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand about the characteristics of different filters.
2. Understand the concept of Approximation Theory.
3. Learn about the switched capacitor filter.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Choose an appropriate transform for the given signal.
CO2	Choose appropriate decimation and interpolation factors for high performance filters.
CO3	Model and design an AR system.
CO4	Implement filter algorithms on a given DSP processor platform.

Unit	Topics	Lectures
I	Introduction: Fundamentals, Types of filters and descriptive terminology, why we use Analog Filters, Circuit elements and scaling, Circuit simulationand modelling. Operational amplifiers: Op-amp models, Op-amp slew rate, Operational amplifiers with resistive feedback: Noninverting and Inverting, Analysing Op-amp circuits, Block diagrams and feedback, The Voltage follower, Addition and subtraction, Application of Op-amp resistor circuits.	8
II	First order filter: Bilinear transfer functions and frequency response – Bilinear transfer function and its parts, realization of passive elements, Bode plots, Active realization, The effect of A(s), cascade design.	8
III	Second order low pass and band pass filters: Design parameters, Second order circuit, frequency response of low pass and band pass circuits, Integrators and others biquads.	8
IV	Second order filters with arbitrary transmission zeros: By using summing, By voltage feed forward, cascade design revisited. Low pass filters with maximally flat magnitude: the ideal low pass filter, Butterworth response, Butterworth pole locations, low pass filter specifications, arbitrary transmission zeros.	8
V	Low pass filter with equal ripple (Chebyshev) magnitude response: The chebyshev polynomial ,The chebyshev magnitude response, Location of chebyshev poles, Comparison of maximally flat & equal–ripple responses, Chebyshev filter design Inverse chebyshev and cauer filters: Inverse chebyshev response, From specifications to pole and zero locations, Cauer magnitude response, Chebyshev rational functions, Cauer filter design.	8

Text Book:

1. Rolf. Schaumann, Haiqiao Xiao, Mac. E. Van Valkenburg, "Analog Filter Design", 2ndIndianEdition, Oxford University Press.

Reference Books:

1. J. Michael Jacob, “Applications and Design with Analog Integrated Circuits”, Second edition,Pearson.
2. T. Deliyannis, Yichuang Sun, J.K. Fidler, “Continuous-Time Active Filter Design”,CRC Press.

Subject Code: BTMEOE803B	BIOECONOMICS	3L:0T:0P	3 Credits

OBJECTIVE:

This course is designed with an objective to provide an understanding of the basic knowledge of bioecomics to students so that they can explore entrepreneurship opportunities in the bio based industry. This course also serves interdisciplinary innovation in terms of sustainable bioeconomy

COURSE OUTCOME: After completion of the course student will be able to:

1. Students will be able to understand basic concept of Bioeconomics, challenges, opportunities& regulations
2. Students will be able to understand development and innovation in terms of bioeconomy towards sustainable development
3. Students will be able to understand Inter- and transdisciplinarity in bioeconomy &research approaches
4. Students will be able to explain biobased resources ,value chain, innovative use of biomass and biological knowledge to provide food, feed, industrial products

Unit	Topics	Lectures
I	Introduction: Fundamentals, Types of filters and descriptive terminology, why we use Analog Filters, Circuit elements and scaling, Circuit simulationand modelling. Operational amplifiers: Op-amp models, Op-amp slew rate, Operational amplifiers with resistive feedback: Noninverting and Inverting, Analysing Op-amp circuits, Block diagrams and feedback, The Voltage follower, Addition and subtraction, Application of Op-amp resistor circuits.	08
II	Economic Growth, Development, and Innovation in terms of bioeconomy, Environmental Economics and the Role of Government, Modelling and Tools Supporting the Transition to a Bioeconomy, Role of biobased Economy in sustainable development.	08
III	Inter- and transdisciplinarity in Bioeconomy & research approaches, primary production, processing of bio based resources, Markets, Sustainability Management and Entrepreneurship in biobased products.	08
IV	Biobased Resources and Value Chains, Processing of Biobased Resources, Markets, Sustainability Management and Entrepreneurship opportunity in biobased product. Food Security and Healthy Nutrition in the Context of the Bioeconomy, Use of Biomass for the Production of Fuel and Chemicals, The importance of Biotechnology for the Bioeconomy.	08
V	sustainable and innovative use of biomass and biological knowledge to provide food, feed, industrial products, bioenergy and ecological services, importance of bioeconomy- related concepts in public, scientific, and political discourse, Dynamic Management of Fossil Fuel, Biofuel.	08

Text Book:

1. Principles of Bioeconomics by I. Sundar, Vedams eBooks (P) Ltd New Delhi, India
2. Bioeconomy:Shaping the Transition to a Sustainable, Biobased Economy by Iris Lewandowski, Springer.
3. Sociobiology and Bioeconomics by Koslowski, Peter
4. Modeling, Dynamics, Optimization and Bioeconomics I, by Pinto, Alberto Adrego, Zilberman, David, Springer.

Subject Code: BTMEOE803C	Design Thinking	3L:0T:0P	3Credits

Objective:

The objective of this course is to familiarize students with design thinking process as a tool for breakthrough innovation. It aims to equip students with design thinking skills and ignite the minds to create innovative ideas, develop solutions for real- time problems

Unit	*Topics*	Lectures
I	Introduction to design thinking, traditional problem solving versus design thinking, history of design thinking, wicked problems. Innovation and creativity, the role of innovation and creativity in organizations, creativity in teams and their environments, design mindset. Introduction to elements and principles of design, 13 Musical Notes for Design Mindset, Examples of Great Design, Design Approaches across the world	8
II	Understanding humans as a combination of I (self) and body, basic physical needs up to actualization, prosperity, the gap between desires and actualization. Understanding culture in family society, institution, startup, socialization process. Ethical behavior: effects on self, society, understanding core values and feelings, negative sentiments and how to overcome them, definite human conduct: universal human goal, developing human consciousness in values, policy, and character. Understand stakeholders, techniques to empathize, identify key user problems. Empathy tools- Interviews, empathy maps, emotional mapping, immersion and observations, customer journey maps, and brainstorming, Classifying insights after Observations, Classifying Stakeholders, Do's & Don'ts for Brainstorming, Individual activity- 'Moccasin walk'	8
III	Defining the problem statement, creating personas, Point of View (POV) statements. Research- identifying drivers, information gathering, target groups, samples, and feedbacks. Idea Generation-basic design directions, Themes of Thinking, inspirations and references, brainstorming, inclusion, sketching and presenting ideas, idea evaluation, double diamond approach, analyze – four W's, 5 why's, "How Might We", Defining the problem using Ice-Cream Sticks, Metaphor & Random Association Technique, Mind-Map, ideation activity games - six thinking hats, million-dollar idea, introduction to visual collaboration and brainstorming tools - Mural, JamBoard	8
IV	Fundamental concepts of critical thinking, the difference between critical and ordinary thinking, characteristics of critical thinkers, critical thinking skills-linking ideas, structuring arguments, recognizing incongruences, five pillars of critical thinking, argumentation versus rhetoric, cognitive bias, tribalism, and politics. Case study on applying critical thinking on different scenarios.	8

V	The argument, claim, and statement, identifying premises and conclusion, truth and logic conditions, valid/invalid arguments, strong/weak arguments, deductive argument, argument diagrams, logical reasoning, scientific reasoning, logical fallacies, propositional logic, probability, and judgment, obstacles to critical thinking. Group activity/role plays on evaluating arguments.	8

Text Book:

1. Vijay Kumar, 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization, 2013, John Wiley and Sons Inc, New Jersey
2. BP Banerjee, Foundations of Ethics and Management, 2005, Excel Books
3. Gavin Ambrose and Paul Harris, Basics Design 08: Design Thinking, 2010, AVA Publishing SA
4. Roger L. Martin, Design of Business: Why Design Thinking is the Next Competitive Advantage, 2009, Harvard Business Press, Boston MA

Course Outcome: After successful completion of the course the students will be able to:

1. Develop a strong understanding of the design process and apply it in a variety of business settings
2. Analyze self, culture, teamwork to work in a multidisciplinary environment and exhibit empathetic behavior
3. Formulate specific problem statements of real time issues and generate innovative ideas using design tools
4. Apply critical thinking skills in order to arrive at the root cause from a set of likely causes
5. Demonstrate an enhanced ability to apply design thinking skills for evaluation of claims and arguments.

Subject Code: BTMEOE803D	Introduction to Women's and Gender Studies	3L:0T:0P	3Credits

Unit	*Topic*	Lectures
I	**Women and Society:** Understanding Sex- Gender, Gender shaping Institutions, Theories of Gender construction Understanding Sexism and Androcentrism, Understanding Patriarchy and Theories of Patriarchy, Private and Public dichotomy, Sexual Division of Work, Patriarchy practices in different institutions and Text Books.	8
II	**Feminist Theory:** Rise of Feminism, Introduction to various stands of Feminism- Liberal Feminism, Radical Feminism, Marxist Feminism, Socialist Feminism, Cultural Feminism, Eco-Feminism, Post Colonial Feminism, Post Modern Feminism. Waves of Feminism.	8
III	**Women's Movement:** The socio-economic conditions of women during the age of Industrial revolution the Call for Women's Rights 1848, Women's rights movement 1848-1920,Historical Developments of Social Reform Movements in India , Women's groups and organizations, Women's Movement Movements for Uniform Civil code and ShahBano case, Dalit women and the question of double marginality.	8
IV	**Gender Roles and Psychology of Sex:** Difference Conceptualization of gender roles and gender role attitudes, Gender: Aggression, Achievement, Communication, Friendship and Romantic, Relationships Sex Differences in Mental Health Trauma relating to Rape , Taboo , Childhood Sexual Abuse , Domestic Violence , Sexual Harassment at Work Place, Educational Institutions, Eve Teasing etc.	8
V	**Gender and Representation:** Gender and Mass Media- Print Media, Gender and Mass Media-Electronic Media, Gender and Films, Advertisements, Mega Serials, Stereotyping and breaking the norms of women's roles Women's Representation in Literary Texts.	8

Suggested reading:

1. Basab iChakrabarti, Women's Studies: Various Aspects. UrbiPrakashani2014
2. Arvind Narrain. Queer: Despised Sexuality Law and Social Change. Book for Change. 2005
3. Chandra Talpade Mohanty, Feminism without Borders: Decolonizing Theory, Practicing Solidarity. Duke University Press.
4. Flavia Agnes. Law and Gender Inequality: The Politics of Women's Rights in India.

   Oxford University Press, 2001

5. Sonia Bathla, Women, Democracy and the Media: Cultural and Political Representations in the Indian Press, Sage, New Delhi, 1998.

Subject Code: BTMEOE803E	Quality Management	3L:0T:0P	3Credits

COURSE OBJECTIVE: Students undergoing this course are expected to-

1. Introduce the importance of quality in improving competitiveness.
2. Understand the Implication of Quality on Business.
3. Implement Quality Implementation Programs.
4. Have exposure to challenges in Quality Improvement Programs.

COURSE OUTCOME: After completion of the course student will be able to-

CO1: Realize the importance of significance of quality.

CO2: Manage quality improvement teams.

CO3: Identify requirements of quality improvement programs.

CO4: Identify improvement areas based on cost of poor quality.

CO5: Organize for quality and development of quality culture through small group activities.

Unit	Topic	Lectures
1	Quality Concepts: Evolution of Quality Control, concept change, TQM Modern concept, Quality concept in design, Review of design, Evolution of proto type. Control on Purchased Product: Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure. Manufacturing Quality: Methods and techniques for manufacture, inspection and control of product, quality in sales and services, guarantee, analysis of claims.	**8**
2	Quality Management: Organization structure and design, quality function, decentralization, designing and fitting, organization for different type products and company, economics of quality value and contribution, quality cost, optimizing quality cost, seduction program. Human Factor in quality Attitude of top management, cooperation of groups, operators attitude, responsibility, causes of apparatus error and corrective methods.	**8**
3	Control Charts, Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts. Attributes of Control Chart, Defects, construction and analysis of charts, improvement by control chart, variable sample size, construction and analysis of C charts.	**8**
4	Defects diagnosis and prevention defect study, identification and analysis of defects, correcting measure, factors affecting reliability, MTTF, calculation of reliability, building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.	**8**
5	ISO-9000 and its concept of Quality Management, ISO 9000 series, Taguchi method, JIT in some details.	**8**

Text and Reference Books:

1. Lt. Gen. H. Lal, "Total Quality Management", Eastern Limited, 1990.
2. Greg Bounds, "Beyond Total Quality Management", McGraw Hill, 1994.

Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992

Subject Code: BTMEOE803F	Modeling of Field-Effect Nano Devices	3L:0T:0P	3Credits

COURSE OBJECTIVE: Students undergoing this course are expected to-

1. Introduce novel MOSFET devices and understand the advantages of multi-gate devices.
2. Introduce the concepts of nanoscale MOS transistor and their performance characteristics.
3. Study the various nano-scaled MOS transistor circuits.

COURSE OUTCOME: After completion of the course student will be able to-

CO1: Study the MOS devices used below 10nm and beyond with an eye on the future.

CO2: Understand and study the physics behind the operation of multi-gate systems.

CO3: Design circuits using nano-scaled MOS transistors with the physical insight of their functional characteristics.

CO4: Understand and study the physics behind the Radiation effects in SOI MOSFETs.

CO5: Understand the impact of device performance on digital circuits.

Unit	Topic	Lectures
1	MOSFET scaling, short channel effects - channel engineering - source/drain engineering - high k dielectric - copper interconnects - strain engineering, SOI MOSFET, multigate transistors – single gate – double gate – triple gate – surround gate, quantum effects – volume inversion – mobility – threshold voltage – inter subband scattering, multigate technology – mobility – gate stack	**8**
2	MOS Electrostatics – 1D – 2D MOS Electrostatics, MOSFET Current-Voltage Characteristics – CMOS Technology – Ultimate limits, double gate MOS system – gate voltage effect - semiconductor thickness effect – asymmetry effect – oxide thickness effect – electron tunnel current – two dimensional confinement, scattering – mobility	**8**
3	Silicon nanowire MOSFETs – Evaluvation of I-V characteristics – The I-V characteristics for nondegenerate carrier statistics – The I-V characteristics for degenerate carrier statistics – Carbon nanotube – Band structure of carbon nanotube – Band structure of graphene – Physical structure of nanotube – Band structure of nanotube – Carbon nanotube FETs – Carbon nanotube MOSFETs – Schottky barrier carbon nanotube FETs – Electronic conduction in molecules – General model for ballistic nano transistors – MOSFETs with 0D, 1D, and 2D channels – Molecular transistors – Single electron charging – Single electron transistors.	**8**

4	Radiation effects in SOI MOSFETs, total ionizing dose effects – single-gate SOI – multi-gate devices, single event effect, scaling effects	**8**
5	Digital circuits – impact of device performance on digital circuits – leakage performance trade off – multi VT devices and circuits – SRAM design, analog circuit design – transconductance - intrinsic gain – flicker noise – self heating –band gap voltage reference – operational amplifier – comparator designs, mixed signal – successive approximation DAC, RF circuits.	**8**

Text and Reference Books:

1. J P Colinge, "FINFETs and other multi-gate transistors", Springer – Series on integrated circuits and systems, 2008
2. Mark Lundstrom, Jing Guo, "Nanoscale Transistors: Device Physics, Modeling and Simulation", Springer, 2006
3. M S Lundstorm, "Fundamentals of Carrier Transport", 2nd Ed., Cambridge University Press, Cambridge UK, 2000.

Subject Code: BTMEOE803G	Computerized Process Control	3L:0T:0P	3Credits

COURSE OBJECTIVE: Students undergoing this course are expected to-

1. Understand Basics of Computer-Aided Process Control.
2. Analyse Industrial communication System.
3. Design Process Modelling for computerized Process control.
4. Design Advanced Strategies For Computerised Process control.
5. Analyse Computerized Process Control.

COURSE OUTCOME: After completion of the course student will be able to-

CO1: Understand the Role of computers in process control, Elements of a computer aided Process control System, Classification of a Computer.

CO2: Design Phase Locked Local Loop, Mixers. Time Division Multiplexed System – TDM/PAM system.

CO3: Realize Process model, Physical model, Control Model. Modelling Procedure.

CO4: Formulate of Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control.

CO5: Design Electric Oven Temperature Control, Reheat Furnace Temperature control.

Unit	Topic	Lectures
1	Basics of Computer-Aided Process Control: Role of computers in process control, Elements of a computer aided Process control System, Classification of a Computer –Aided Process Control System Computer Aided Process–control Architecture: Centralized Control Systems, Distributed control Systems, Hierarchical Computer control Systems. Economics of Computer-Aided Process control. Benefits of using Computers in a Process control. Process related Interfaces: Analog Interfaces, Digital Interfaces, Pulse Interfaces, Standard Interfaces.	**8**
2	Industrial communication System: Communication Networking, Industrial communication Systems, Data Transfer Techniques, Computer Aided Process control software, Types of Computer control Process Software, Real Time Operating System	**8**
3	Process Modelling for computerized Process control: Process model, Physical model, Control Model, Process modelling. Modelling Procedure: Goals Definition, Information Preparation, Model Formulation, Solution Finding, Results Analysis, Model Validation	**8**

4	Advanced Strategies For Computerised Process control: Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control.	**8**
5	Examples of Computerized Process Control: Electric Oven Temperature Control, Reheat Furnace Temperature control, Thickness and Flatness control System for metal Rolling, Computer-Aided control of Electric Power Generation Plant.	**8**

Text Books:

1. S. K. Singh, "Computer Aided Process control", PHI.

Reference Books:

1. C. L. Smith, "Digital computer Process Control", Ident Educational Publishers.
2. C. D. Johnson, "Process Control Instrumentation Technology", PHI.
3. Krishan Kant, "Computer Based Industrial Control"
4. Pradeep B. Deshpande & Raymond H. Ash, "Element of Computer Process Control with Advance Control Applications", Instrument Society of America, 1981.
5. C. M. Houpis & G. B. Lamond, "Digital Control System Theory", Tata McGraw Hill.

Project

Subject Code: BTME804P