VR20

MECHANICAL ENGINEERING

B. Tech.

Four years Syllabus

Department of Mechanical Engineering

(B.Tech.Programme Accredited by NBA)

[VR20]

Applicable for the batch of students admitted from the Academic Year 2020-21

VELAGAPUDI RAMAKRISHNA
SIDDHARTHA ENGINEERING COLLEGE
(An Autonomous, ISO 9001:2015 Certified Institution)
(Approved by AICTE, Accredited by NAAC, Affiliated to JNTUK, Kakinada)
(Sponsored by Siddhartha Academy of General & Technical Education)
Kanuru, Vijayawada
Andhra Pradesh - 520007, INDIA.
www.vrsiddhartha.ac.in

w.e.f. 2020-21

Department of Mechanical Engineering

PROGRAM OUTCOMES (PO's)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and engg. specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and Responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Objectives (PSO's)

1) Apply their Knowledge in the domain of thermal systems to solve engineering problems using modern technological tools.

2) Develop and implement new ideas related to product design and manufacturing for societal and industrial needs using modern CAD/CAE/CAM tools.

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VR 20 SCHEME OF INSTRUCTION FOR FIRST SEMESTER UG PROGRAM

SEMESTER I **CONTACT HOURS: 27**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1.	20BS1101	Basic Science	Matrices and Differential Calculus	3	0	0	**3**
2.	20BS1102	Basic Science	Engineering Chemistry	3	0	0	**3**
3.	20ES1103	Engineering Science	Programming for Problem Solving	3	0	0	**3**
4.	20ES1104C	Engineering Science	Engineering Mechanics – I (ME)	3	0	0	**3**
5.	20ES1105	Engineering Science	Engineering Graphics	1	0	4	**3**
6.	20BS1151B	Basic Science	Engineering Chemistry Laboratory	0	0	3	**1.5**
7.	20ES1152	Engineering Science	Programming for Problem Solving Laboratory	0	0	3	**1.5**
8.	20ES1153	Engineering Science	Engineering Workshop	0	0	3	**1.5**
9.	20MC1106	Mandatory Course	Technology and Society	1	0	0	**-**
Total				**14**	**0**	**13**	**19.5**
10.	20MC1107	Mandatory Course	Induction Program				**-**

Category	Credits
Basic Science Courses	3+3+1.5 = 7.5
Engineering Science Courses	3+3+3+1.5+1.5 = 12
Humanities and Social Science Courses	0
Mandatory Courses	0
TOTAL CREDITS	**19.5**

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VR 20 SCHEME OF INSTRUCTION FOR SECOND SEMESTER UG PROGRAM

SEMESTER II **CONTACT HOURS: 26**

S. No	Course Code	Course Category	Course Name	L	T	P	Credits
1.	20BS2101	Basic Science	Laplace Transforms and Integral Calculus	3	0	0	**3**
2.	20BS2102A 20BS2102B	Basic Science	Engineering Physics (EEE) Physics for Engineers (CE/ME)	3	0	0	**3**
3.	20ES2103B	Engineering Science	Python Programming	3	0	0	**3**
4.	20ES2104D 20ES2104E 20ES2104F	Engineering Science	Engineering Mechanics(CE) Network Analysis (EEE) Engineering Mechanics – II (ME)	3	0	0	**3**
5.	20HS2105	Humanities and Social Science	Technical English and Communication Skills	2	0	0	**2**
6.	20BS2151A	Basic Science Course	Engineering Physics Laboratory	0	0	3	**1.5**
7.	20ES2152B	Engineering Science	Python Programming Laboratory	0	0	3	**1.5**
8.	20HS2153	Humanities and Social Science	Technical English and Communication Skills Laboratory	0	0	3	**1.5**
9	20ES2154	Engineering Science	Computing and Peripherals Laboratory	0	0	2	**1**
10.	20MC2106	Mandatory Course	Professional Ethics and Practice	1	0	0	**-**
Total				**15**	**0**	**11**	**19.5**

Category	**Credits**
Basic Science Courses	3+3+1.5 = 7.5
Engineering Science Courses	3+3+1.5+1 = 8.5
Humanities and Social Sciences	2+1.5 = 3.5
Mandatory Courses	0
TOTAL CREDITS	**19.5**

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VR 20 SCHEME OF INSTRUCTION FOR THIRD SEMESTER UG PROGRAM

SEMESTER III **CONTACT HOURS: 28**

S.No	Course Code	Course	Subject	L	T	P	Credits
1	20BS3101D	Basic Science Course	Mathematics for Mechanical Engineers	3	0	0	3
2	20ME3302	Program Core	Mechanics of Materials	3	0	0	3
3	20ME3303	Program Core	Basic Thermodynamics	3	0	0	3
4	20ME3304	Program Core	Manufacturing Processes	3	0	0	3
5	20ME3305	Program Core	Kinematics of Machines	3	0	0	3
6	20ME3351	Program Core Lab 1	Solid Modeling Laboratory	0	0	3	1.5
7	20ME3352	Program Core Lab 2	Manufacturing Process Laboratory	0	0	3	1.5
8	20ME3353	Program Core Lab 3	Computational Methods Laboratory	0	0	3	1.5
9	20TP3106	**Soft Skills – 1**	**Logic and Reasoning**	**0**	**0**	**2**	**1**
10	20MC3107B	MC (AICTE suggested)	Indian Constitution	2	0	0	-
			Total	**17**	**0**	**11**	**20.5**

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VR 20 SCHEME OF INSTRUCTION FOR FOURTH SEMESTER UG PROGRAM

SEMESTER IV **CONTACT HOURS: 31**

S.No	Course Code	Course	Subject	L	T	P	Credits
1.	20ME4101F	Basic Science/Program Core	Fluid Mechanics and Hydraulic Machines	3	0	0	3
2.	20ES4102A	Engineering Science Course	Electrical and Electronics Engineering	3	0	0	3
3.	20ME4303	Program Core	Machine Dynamics	3	0	0	3
4.	20ME4304	Program Core	Engineering Metallurgy	3	0	0	3
5.	20HS4105	Humanities and Social Sciences	Universal Human Values	3	0	0	3
6.	20ES4351	Engineering Sciences Lab	Electrical and Electronics Engineering Laboratory	0	0	3	1.5
7.	20ME4352	Program Core Lab	SM &FM Lab	0	0	3	1.5
8.	20ES4353	Engineering Sciences Lab	Programmable Logic Controllers Lab	0	0	3	1.5
9.	20TP4106	**Soft Skills – 2**	**English for Professionals**	**0**	**0**	**2**	**1**
10.	20 ME4607	**Skill Oriented Course 1**	**Robotics Lab**	**1**	**0**	**2**	**2**
11	20MC4108A	MC (AICTE suggested)	Environmental Studies	**2**	**0**	**0**	**-**
Total				**18**	**0**	**13**	**22.5**
	Summer Internship six weeks (Mandatory) during summer vacation (EPICS)						

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VR 20 SCHEME OF INSTRUCTION FOR FIFTH SEMESTER UG PROGRAM

SEMESTER V **CONTACT HOURS: 34**

S.No	Course Code	Course	Subject	L	T	P	Credits
1	20ME5301	Program Core	**Applied Thermodynamics**	3	0	0	3
2	20ME5302	Program Core	**Design of Machine Elements**	3	0	0	3
3	20ME5303	Program Core	**Machine Tools and Metal Cutting**	2	0	0	2
4	20ME5404	Program Elective 1	**A. IC Engines & Gas Turbines** **B. Refrigeration and Air Conditioning** **C. Jet & Rocket Propulsion**	2	0	2	3
5	20ME5205	Open Elective /Job oriented elective	**A. Robotics** **B. Computer Graphics and Geometrical Modelling**	3	0	0	3
6	20ME5351	Program Core Lab 1	**Fuels and IC Engines Laboratory**	0	0	3	1.5
7	20ME5352	Program Core Lab 2	**Machine Tools Laboratory**	0	0	3	1.5
8	20ME5353	Program core lab 3	**Design and Metrology Lab**	0	0	3	1.5
9	**20TP5106**	**Soft Skills – 3**	**Personality Development**	**0**	**0**	**2**	**1**
10	**20ME5354**	**Internship / Project (6 Weeks)**	**EPICS/Internship**	**0**	**0**	**3**	**1.5**
11	**20ME5607**	**Skill Oriented course -2**	**Mechatronics Lab**	**1**	**0**	**2**	**2**
11.	**20MC5108 B**	**Mandatory Course** **(AICTE suggested)**	**Innovation, IPR and Entrepreneurship**	**2**	**0**	**0**	**-**
			Total	**16**	**0**	**18**	**23**

Category	**Credits**
Program Core Courses	12.5
Humanities and Social Sciences	0
Program Elective Courses	3
Open Elective Course	3
Skill Oriented courses	3
Internship/Project	1.5
Mandatory Course (AICTE)	0
TOTAL CREDITS	**23**

Note: Open Elective Courses may be opted as self-learning courses. Students can register and complete the course in approved MOOCS Platform on or before last instruction day of V Semester. They have to submit the certificate before the last instruction day of V semester

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VR 20 SCHEME OF INSTRUCTION FOR SIXTH SEMESTER UG PROGRAM

SEMESTER VI **CONTACT HOURS: 29**

S.No	Course Code	Course	Subject	L	T	P	Credits
1	20ME6301	Program Core	**Design of Transmission Systems**	3	0	0	3
2	20ME6302	Program Core	**Heat Transfer**	3	0	0	3
3	20HS6103	Humanities & Social Sciences	**Engineering Economics and management**	2	0	0	2
4	20ME6404	Program Elective 2	**A. Finite Element Method** **B. Mechanical Vibrations** **C. Advanced Mechanics of Materials**	3	0	0	3
5	20ME6205	Open Elective /Job oriented elective -2	**A. Mechatronics, B. Additive Manufacturing**	2	0	2	3
6	20ME6351	Program Core Lab 1	**Simulation and Analysis Lab**	0	0	3	1.5
7	20ME6352	Program Core Lab 2	**Heat Transfer Laboratory**	0	0	3	1.5
8	20HS6153	Humanities & Social Sciences Lab	**English Communications Skill lab**	0	0	2	1
9.	20TP6106	**Soft Skills –4**	**Quantitative Aptitude**	**0**	**0**	**2**	**1**
10.	20ME6554	**Internship/project**	**Mini Project -1**	0	0	2	1
11.	20MC6107 B	Mandatory Course (AICTE suggested)	**Biology for Engineers**	2	0	0	0
			Total	**15**	**0**	**14**	**20**

Category	Credits
Program Core Courses	9
Humanities and Social Sciences	3
Program Elective Courses	3
Open Elective Courses	3
Skill Oriented courses	1
Mandatory Course (AICTE)	0
Internship/ Project	1
TOTAL CREDITS	**20**

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VR 20 SCHEME OF INSTRUCTION FOR SEVENTH SEMESTER UG PROGRAM

SEMESTER VII **CONTACT HOURS: 29**

S.No	Course Code	Course	Subject	L	T	P	Credits
1	20ME7301	Program Core	**Computer Aided Manufacturing**	2	0	2	3
2	20ME7402	Program Elective 3	**A. Metrology** **B. Theory of Metal Cutting** **C. Metal Forming**	3	0	0	3
3	20ME7403	Program Elective 4	**A. Operations Research** **B. Manufacturing Management** **C. Flexible Manufacturing Systems & Group Technology**	3	0	0	3
4	20ME7404	Program Elective 5	**A. Computational Fluid Dynamics** **B. Energy Resource Utilization** **C. Automobile Engineering**	3	0	0	3
5	20ME7205	Open Elective /Job oriented elective-3	**A. Electric & Hybrid Vehicles** **B. Solar Energy Utilization**	2	0	2	3
6	20ME7206	Open Elective /Job oriented elective-4	**A. Project Management** **B. Statistical Quality Control**	2	0	2	3
7	**20ME7607**	**Advanced Skill Course**	**Computational fluid Dynamics Lab**	1	0	2	2
8	20ME7551	**Internship/Project**	**Mini Project - II**	0	0	3	1.5
9	20ME7552	**Internship/Project**	**Industrial / Research Internship**	**0**	**0**	**3**	**1.5**
			Total	**17**	**0**	**12**	**23**

Category	Credits
Program Core	3
Program Elective	9
Open Electives	6
Skill Oriented Courses	2
Internship/ Project	3
TOTAL CREDITS	**23**

Note: Open Elective Courses 3 & 4 may be opted as self-learning courses. Students can register and complete the course in approved MOOCS platform on or before last instruction day of VII Semester. They have to submit the certificate before the last instruction day of VII semester

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VR 20 SCHEME OF INSTRUCTION FOR EIGHT SEMESTER UG PROGRAM

SEMESTER VIII **CONTACT HOURS: 24**

S.No	Course Code	Course	Subject	L	T	P	Credits
1	20ME8551	**Internship/Project**	**Major Project and Internship (6 Months)**	0	0	24	12
			Total	0	0	24	12

FIRST SEMESTER

20BS1101
MATRICES AND DIFFERENTIAL CALCULUS

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3 - 0 - 0
Prerequisites:	Fundamentals of Matrices, Fundamentals of Calculus, Integration, Differentiation.	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Determine Eigen values, Eigen vectors of a matrix.
CO2	Estimate Maxima and Minima of Multivariable functions.
CO3	Solve the Linear differential equations with constant coefficients.
CO4	Solve the Linear differential equations with variable coefficients.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**H**	**M**			**M**							
CO2	**H**	**M**			**M**							
CO3	**H**	**M**			**M**							
CO4	**H**	**M**			**M**							

COURSE CONTENT

UNIT I

Matrices: Consistency of Linear System of Equations, Linear Transformations, Vectors, Eigen values and Eigen vectors, Properties of Eigen values, Finding Inverse and Powers of a Matrix by Cayley-Hamilton Theorem. Reduction to Diagonal form, Reduction of Quadratic form to Canonical form, Nature of a Quadratic form, Complex matrices.

UNIT II

Differential Calculus: Fundamental Theorems-Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem and Taylor's Theorem, Expansions of functions-Maclaurin's Series and Taylor's Series.
Application: Curvature, Radius of Curvature**.**

Functions of two or more Variables: Taylor's Theorem for Function of two Variables, Maxima and Minima of Functions of two Variables, Lagrange's Method of Undetermined Multipliers.

UNIT III

Differential Equations of First Order:Exact Differential Equations, Equations Reducible to Exact Equations.
Applications: Orthogonal Trajectories, Newton's Law of Cooling.
Linear Differential Equations of Higher Order: Definitions, Operator D, Rules for Finding the Complementary Function, Inverse Operator, Rules for finding Particular Integral, Working Procedure to Solve the Equation.

UNIT IV

Method of Variation of Parameters, Method of Undetermined Coefficients, Equations Reducible to Linear Equations with Constant Coefficients: Cauchy's Homogeneous Linear Equation, Legendre's Linear Equation, Linear Dependence of Solutions, Simultaneous Linear Equations with Constant Coefficients.
Application: L-C-R Circuits.

TEXT BOOK

1. B.S.Grewal , Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2019.

REFERENCE BOOKS

[1].Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th Edition, 2015.

[2].B.V.Ramana, Higher Engineering Mathematics, Tata MC Graw Hill, 1st Edition, 2007.
[3].N.P.Bali, Dr.Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications, 9th Edition, 2014.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1]. www.nptel videos.com/mathematics/ (Math Lectures from MIT,Stanford,IIT'S)

[2]. nptel.ac.in/courses/122104017

[3]. nptel.ac.in/courses/111105035

[4]. Engineering Mathematics Open Learning Project.
www.3.ul.ie/~mlc/support/Loughborough%20website/

20BS1102
ENGINEEERING CHEMISTRY

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Chemistry knowledge at Intermediate level	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Analyze various water treatment methods and boiler troubles.
CO2	Apply the concept of phase equilibrium to different materials and the knowledge of working of electrodes and batteries in various technological fields.
CO3	Evaluate corrosion processes as well as protection methods.
CO4	Apply the knowledge of conventional fuels and mechanistic aspects of conducting polymers for their effective and efficient utilisation.

Contribution of Course Outcomes towards achievement of Program Outcomes (L - Low, M - Medium, H - High

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**M**											
CO2	**M**											
CO3	**M**											
CO4	**M**											

COURSE CONTENT

UNIT I **(10 hours)**

Water technology-I: WHO standards - Water treatment for drinking purpose - sedimentation, coagulation, filtration, disinfection by chlorination, breakpoint chlorination and its significance - Desalination of brackish water - principle and process of electrodialysis and reverse osmosis, advantages and disadvantages.

Water technology-II: Boiler troubles - scales-formation, disadvantages and internal conditioning methods - phosphate conditioning, calgon conditioning and sodium aluminate, caustic embrittlement- reasons, mechanism and its control, and boiler corrosion – causes and control.

UNIT II **(10 hours)**

Phase rule and applications: Definition and explanation of the terms – phase, component and degree of freedom, phase rule equation, phase equilibria of single component system – water system, two component system – silver-lead system, applications of phase rule.

Electrochemistry: Construction and working of Calomel electrode, silver-silver chloride electrode, and principle, construction and working of glass electrode, determination of pH using glass electrode. Chemistry of modern batteries - $Li/SOCl_2$ battery and $Li_xC/LiCoO_2$ battery – construction, working and advantages.
Fuel cells: General working principle of a fuel cell, examples, chemistry of H_2-O_2 fuel cell.

UNIT III (10 hours)

Corrosion principles: Introduction, definition, reason for corrosion, examples – types of electrochemical corrosion - hydrogen evolution and oxygen absorption – corrosion due to dissimilar metals, galvanic series – differential aeration corrosion – pitting corrosion and concept of passivity.

Corrosion control methods: Cathodic protection- principle and types - impressed current method and sacrificial anode method, anodic protection-principle and method, corrosion inhibitors – types and mechanism of inhibition – principle, process and advantages of electroplating and electroless plating.

UNIT IV (10 hours)

Conducting polymers: Definition, examples, classification-intrinsically conducting polymers and extrinsically conducting polymers- mechanism of conduction of undoped polyacetylene, doping of conducting polymers- mechanism of conduction of p-doped and n-doped polyacetylenes – applications of conducting polymers.

Fuel technology: Fuel-definition, calorific value- lower and higher calorific values and numericals on calculation of HCV and LCV relation, analysis of coal – proximate analysis and ultimate analysis, flue gas analysis by Orsat's apparatus, numericals based on calculation of air required for combustion.

TEXT BOOKS

[1] Shikha Agarwal, "Engineering Chemistry – Fundamentals and Applications", Cambridge University Press, New Delhi, 1st edition (2015).

REFERENCE BOOKS

[1] Sunita Rattan , "A Textbook of Engineering Chemistry", S.K. Kataria & Sons, New Delhi, First edition 2012.
[2] P.C. Jain , "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Limited, New Delhi, 15th edition.
[3] B.S. Bahl, G. D. Tuli and Arun Bahl, "Essentials of Physical Chemistry", S. Chand and Company Limited, New Delhi.
[4] O. G. Palanna, " Engineering Chemistry", Tata McGraw Hill Education Pvt. Ltd., New Delhi.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] http://www.cip.ukcentre.com/steam.htm
[2] http://corrosion-doctors.org/Modi;es/mod-basics.htm
[3] http://nopr.niscair.res.in/bitstream/123456789/5475/1/JSIR%2063%289%29%20715-728.pdf
[4] https://chem.libretexts.org/Core/Analytical_Chemistry/Electrochemistry/Basics_of_Electrochemistry
[5] http://www.filtronics.com/blog/tertiary-treatment/stages-in-typical-municipal-water-treatment/
[6] NPTEL online course, "Corrosion Part-I" offered by MHRD and instructed by Prof. Kallol Mondal of IIT Kanpur

20ES1103
PROGRAMMING FOR PROBLEM SOLVING

Course Category:	Engineering Science	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	--	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Understand the different types of problem solving approaches
CO2	Apply the selections, loops, arrays, and string concepts in C to solve problems.
CO3	Apply functions and pointer concepts in C to solve problems.
CO4	Solve problems using enum, structures, unions, and file handling functions.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**H**			**M**									**M**	**M**
CO2	**M**												**M**	**M**
CO3	**M**												**M**	**M**
CO4	**L**												**M**	**M**

COURSE CONTENT

UNIT I

Introduction to computer-based problem solving: Requirement of problem solving by computers, problem definition, Use of examples for problem solving, similarities between problems, Problem solving strategies, steps involved in problem solving.

Program design and implementation issues: programs and algorithms, top-down design and step-wise refinement, construction of loops-basic programming constructs, Implementation, programming environment.

Algorithms for problem solving: Exchanging values of two variables, Summation of a set of numbers, decimal to binary base conversion, reversing the digit of an integer, to find greatest common divisor (GCD) of two numbers, to verify whether an integer is prime or not, organize a given set of numbers in ascending order, find the square root of an integer, factorial of a given number, generate the Fibonacci sequence for n terms, evaluate sin(x) as sum of series, to find the value of the power of a number raised by another integer,

reverse order elements of an array, find largest number in an array, print elements of upper triangular matrix, multiplication of two matrices, to compute to roots of a quadratic equation $ax^2+bx+c=0$.

UNIT II

Introduction to the C Language: Background of C program, Identifiers, Types, Variables, Constants, Memory Layout, Input/Output, Programming Examples.

Structure of a C Program: Logical Data and Operators, Expressions, Precedence and Associatively, Evaluating Expressions, Type Conversion, Statements, Storage Class.

Selection: Two-way Selection, Multiway Selection, More Standard Functions.

Repetition: Concept of a Loop Loops In C, Loop Examples, Recursion, The Calculator Program.

Arrays: Array Concepts in C, Inter-Function Communication, Array Applications, Two Dimensional Arrays, Multidimensional Arrays.

UNIT III

Strings: String Concepts, C Strings, String Input/Output Functions, Arrays of Strings, String Manipulation Functions, String- Data Conversion.

Functions: Functions in C, User Defined Functions, Call by Value, Call Value Reference, Inter-FunctionCommunication, Standard Functions, Scope.

Pointers: Introduction to Pointer, Pointers for Inter-Function Communications, Pointers to Pointers, Compatibility, Lvalue and Rvlaue.

Pointer Applications: Arrays and Pointers, Pointer Arithmetic and Arrays, Passing an Array to a Function, Memory Allocations Functions, Array of Pointers.

UNIT IV

Enumerations: The Type Definition(Typedef), Enumerated Types: Declaring an Enumerated Type , Operations on Enumerated Types, Enumeration Type Conversion, Initializing Enumerated Constants, Anonymous Enumeration: Constants, Input/Output Operators.

Structures: Structure Type Declaration, Initialization, Accessing Structures, Operations on Structures, Complex Structures, Structures and Functions, Sending the Whole Structure, Passing Structures through Pointers.

Unions: Referencing Unions, Initializers, Unions and Structures, Internet Address, Programming Applications.

File Handling: Files, Streams, Standard Library Input/Output Functions, Formatting Input/output Functions and Character Input/Output Functions, Command-Line Arguments.

TEXT BOOKS

[1]. Programming and Problem Solving Through "C" Language By HarshaPriya, R. Ranjeet · Firewall media 2006

[2]. Behrouz A. Forouzan and Richard F. Gilberg, “Computer Science A Structured Programming Approach Using C”, CENGAGE Learning, Third Edition

REFERENCE BOOKS

[1]. Anil B. Chaudhuri, “Flowchart and Algorithm Basics: The Art of Programming”, Mercury Learning & Information, 2020.

[2]. R.G. Dromey, “How to Solve it By Computer”, Prentice-Hall International Series in Computer Science,1982.

[3]. YashwantKanetkar , “Let us C” , BPB Publications, 16th Edition 2017.
[4]. Kernighan and Ritchie,“The C programming language”, The (Ansi C Version), PHI, second edition.
[5]. Paul J. Dietel and Harvey M. Deitel, “C: How to Program”, Prentice Hall, 8th edition (Jan 19 ,2021).
[6]. K.R.Venugopal, Sundeep R. Prasad, “Mastering C”, McGraw Hill, 2nd Edition, 2015.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] Computer Science and Engineering - Noc:problem Solving Through Programming in C. [online] https://nptel.ac.in/courses/106/105/106105171/
[2] Computer Science and Engineering - Noc:introduction To Programming in C. [online] https://-nptel.ac.in/courses/106/104/106104128/
[3] C For Everyone: Structured Programming. [online]https://www.coursera.org/learn/c-structured -programming
[4] Advanced C Programming CourseTim Academy-Jason Fedin. [online] https://www.udemy.com/-course/advanced-c-programming-course/

20ES1104C
ENGINEERING MECHANICS-I (ME)

Course Category:	Engineering Science	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3 - 0 - 0
Prerequisites:	Basic Mathematics, Physics at (10 + 2) level	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Analyze coplanar concurrent forces
CO2	Analyze coplanar parallel forces and evaluate centroid and moment of inertia for plane figures.
CO3	Analyze coplanar general case of force systems
CO4	Analyze spatial concurrent and parallel forces

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**H**	**M**	**M**											**M**
CO2	**H**	**M**	**M**											**M**
CO3	**H**	**M**	**M**											**M**
CO4	**H**	**M**	**M**											**M**

COURSE CONTENT

UNIT – I

Concurrent Forces in a Plane: Principles of statics, Force, Addition of two forces: Parallelogram Law – Composition and resolution of forces – Constraint, Action and Reaction. Types of supports and support reactions. Free body diagram. Equilibrium of concurrent forces in a plane – Method of projections – Moment of a force, Theorem of Varignon, Method of moments.

UNIT – II

Parallel Forces in a Plane: Introduction, Types of parallel forces, Resultant. Couple, Resolution of Force into force and a couple. General case of parallel forces in a plane.

Centroids: Introduction, Determination of centroids by integration method, Centroids of composite plane figures, Distributed forces in a plane.

Moment of Inertia of Plane Figures: Moment of Inertia of a plane figure with respect to an axis in its plane – Moment of inertia with respect to an axis perpendicular to the plane of the figure, Radius of gyration – Parallel axis theorem, MI of composite plane figures.

UNIT – III

General Case of Forces in a Plane: Composition of forces in a plane – Equilibrium of forces in a plane - Plane Trusses**:** Method of joints and Method of Sections

Friction: Introduction, Laws of dry friction. Co-efficient of friction, Angle of friction, Angle of repose, Cone of friction, Frictional forces on wheel, Wedge friction.

UNIT – IV

Force System In Space: Components of a force, defining a force by its magnitude and two points on its line of action, components of a vector, Resultant of system of concurrent and parallel forces in space, Moment of a force, Component of a vector and moment about an axis, Equilibrium of concurrent and parallel forces in space.

TEXT BOOKS

[1] Engineering Mechanics by S. Timoshenko & D. H. Young, 4th Edition, 2007, McGraw Hill International Edition. (For Concepts and symbolic Problems).
[2] Engineering Mechanics Statics and dynamics by A. K. Tayal, 13th Edition, 2006, Umesh Publication, Delhi, (For numerical Problems using S.I.System of Units).

REFERENCE BOOKS

[1] Beer and Johnston, "Vector Mechanics for Engineers Statics and Dynamics",IIIrd edition, Tata McGraw Hill, 2010.
[2] SS Bhavikatti and KG Rajasekharappa, "Engineering Mechanics", IVth Edition, New Age International Private Limited, 2012
[3] K.Vijaya Kumar Reddy and J Suresh Kumar, " Singer's Engineering Mechanics Statics and Dynamics", IIIrd Edition BS Publications, 2010.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] http://emweb.unl.edu/
[2] https://nptel.ac.in/courses/122/104/122104015/

20ES1105
ENGINEERING GRAPHICS

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory & Practice	**Lecture -Tutorial-Practice:**	1 - 0 - 4
Prerequisites:	Nil	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Understand the Scales and conics.
CO2	Draw Orthographic projections of points, Lines and Planes.
CO3	Draw Orthographic projections of Solidsand to understand basics of Auto CAD.
CO4	Understand the sections, Developmentsof solids and draw isometric views using Auto CAD.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**H**		**H**							**H**				**L**
CO2	**M**		**H**							**H**				**L**
CO3	**M**		**H**							**H**				**L**
CO4	**L**		**H**							**H**				**L**

COURSE CONTENT

UNIT – I

Introduction to Engineering Drawing: Principles of Engineering Graphics and their Significance

Scales: Construction of plain and diagonal Scales

Conic Sections: Construction of ellipse, parabola and hyperbola (Treatment is limited to Eccentricity or General method only)

UNIT – II

Orthographic Projections: Principles of Orthographic Projections –Projections of Points, Lines (Treatment is limited to First Angle Projection) and Projections of Plane regular geometric figures (Up to Plane Inclined to both of the Reference planes)

UNIT – III

Projections of Solids: Projections of simple solids such as Cubes, Prisms, Pyramids, Cylinders and Cones with varying positions (Limited to Solid Inclined to one of the Reference planes)

INTRODUCTION TO AUTO CAD: Basic introduction and operational instructions of various commands in AutoCAD.**(**Internal Evaluation only**)**

UNIT – IV

Sections and Development of Surfaces of Right Angular Solids:
Sections and sectional views of right angular solids of Prism, Pyramid and Cone, Development of surfaces of Right Regular Solids of Prism, Pyramid and Cone.
Isometric Projections: Conversion of isometric views into Orthographic Projections of simple castingsusing Auto CAD. (Treatment is limited to simple objects only, Internal Evaluation only).

TEXT BOOKS

[1] BasanthAgrawal& C M Agrawal," Engineering Drawing", McGraw Hill Education Private Limited, New Delhi.
[2] N.D. Bhatt "Engineering Drawing", Charotar Publishing House, Anand. 53rd Edition – 2019.

REFERENCE BOOKS

[1] K. L. Narayana& P. Kannaiah, "Text Book on Engineering Drawing", Scitech publications (India) Pvt. Ltd.,Chennai, 2nd Edition - fifth reprint 2006
[2] K. Venugopal, "Engineering Drawing and Graphics + Auto CAD", New Age International, New Delhi
[3] D M Kulkarni, AP Rastogi, AK Sarkar, "Engineering Graphics with Auto CAD", PHI Learning Private Limited, Delhi Edition – 2013

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] http://www.youtube.com/watch?v=XCWJ XrkWco.
[2] http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html# isodrawing.
[3] https://onlinecourses.nptel.ac.in/noc20_me79/preview
[4] http://nptel.ac.in/courses/112/103/112103019/

20BS1151B
ENGINEERING CHEMISTRY LABORATORY

Course Category:	Institutional Core	**Credits:**	1.5
Course Type:	Laboratory	**Lecture -Tutorial-Practice:**	0 - 0 - 3
Prerequisites:	Knowledge of chemistry practicals at Intermediate level	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Analyze ores, commercial samples, quality parameters of water samples from different sources
CO2	Perform quantitative analysis using instrumental methods.
CO3	Apply the knowledge of preparation of polymers, separation of ions, mechanism of corrosion and photochemical reactions.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1				**M**								
CO2				**M**								
CO3				**M**								

COURSE CONTENT

List of Experiments:

1. Determination of MnO_2 in Pyrolusite / Iron in Haematite ore
2. Determination of total alkalinity of a water sample
3. Determination of purity of a boric acid sample
4. Conductometric analysis of a strong base using a strong acid
5. Determination of total hardness of a water sample
6. Determination of copper in a given sample
7. Chemistry of blueprinting
8. Determination of Mohr's salt - Permanganometry
9. Determination of Mohr's salt - Dichrometry
10. Comparison of corrosion rates of different metals
11. Determination of available chlorine in a bleaching powder sample
12. Determination of chlorides in a water sample
13. pH metric analysis of a strong base using a strong acid
14. Preparation of urea-formaldehyde resin
15. Separation of ions by paper chromatography

REFERENCE BOOKS

[1] *S.K. Bhasin and Sudha Rani*, "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing Company, New Delhi, 2nd edition.

[2] *Sunitha Rattan*, "Experiments in Applied Chemistry", S.K. Kataria & Sons, New Delhi, 2nd edition.

20ES1152
PROGRAMMING FOR PROBLEM SOLVING LABORATORY

Course Category:	Engineering Science	**Credits:**	1.5
Course Type:	Lab	**Lecture -Tutorial-Practice:**	0 - 0 - 3
Prerequisites:	---	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Implement the use of programming constructs in a structural programming language.
CO2	Apply the selections, loops, arrays, and string concepts in C to solve problems.
CO3	Apply functions, pointer, and Enum concepts in C to solve problems.
CO4	Solve problems using structures, Unions, and file handling functions.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H				L							M	M	M
CO2				L								M	M	M
CO3	H												M	M
CO4				M								M	M	M

COURSE CONTENT

WEEK – 1 : Introduction to C Programming

a) The Structure of C Program with a sample program.
b) Use identifiers, data types, format specifiers, constants, and variables declaration and initialization to write simple C programs.
c) Write simple C programs using preprocessor commands and simple I/O statements.

WEEK – 2 : Data Types and Variable Declarations

a) Use void, integral and floating point data types in different scenarios to write programs.
b) Use various primitive data types for performing different mathematical operations.
c) Programs to perform mathematical operations using various operators in C

WEEK – 3 : Selection – Making Decisions

a) Write programs using the if...else selection statements.
b) Use nested if...else statement to solve problems that need multi-level selection making decisions.
c) Write programs that use switch...case and else...if multi way statements to select one out of several options.

WEEK – 4 : Looping Constructs and Their Applications

a) To have a clear idea on loop initialization, validation and updation.
b) Write programs using the while, for, or do...while loops.
c) To understand the logic and adopt best looping construct for different kinds of problems.
d) Design and develop programs based on Iterative loops using While, Do While, For, Nested For.

WEEK – 5 : Unconditional Control Transfer Statements

a) Write programs using of (break, and continue) unconditional control transfer statements.
b) Use the goto statement to transfer the control from one part to another part of a program and the use of return statement to end the execution of a called function.

WEEK – 6 : Arrays and Their Applications

a) To utilize one dimensional and multi-dimensional arrays to solve problems that use set(s) of similar type input data.
b) To write programs that perform multiple classical operations like searching, sorting, updation, or deletion on array elements.

WEEK – 7 : Strings, String I/O and Manipulation Functions

a) To write programs that work on read, write and manipulate fixed length and variable-length strings and/or arrays of strings
b) To write programs that use predefined string I/O functions.
c) To write programs that use string manipulation functions from the string library.

WEEK – 8 : Concepts of User Defined Functions

a) Design and develop programs depending on functions both user defined andstandard library functions in C with different approaches.
b) To write a program using more than one function with or without parameters and function return type.

WEEK – 9 : Pointers and Their Applications

a) Programs on declaration of pointers and their usage in C.
b) Programs to relate between arrays and pointers and use them efficiently in a program.
c) To pass pointers as an argument to a function, and use it efficiently in a program.
d) To write programs using static and dynamic memory allocation.

WEEK – 10 : Structure, Union, and Enumeration

a) Programs to define, declare and access structure and union variables
b) Design and develop programs to work with pointers to access data within a structure
c) Programs to pass structure as an argument to a function
d) To write C programs using enumeration data types, an easiest way of mapping symbolic names to integer values.

WEEK – 11 : File Handling Operations

a) Programs to open and close text and binary files using file I/O commands.
b) Write programs to perform read and write operations using the formatting I/O and character I/O functions.
c) Apply file positioning, status and system commands based on a problem requirements.

WEEK – 12 : Command Line Arguments

a) To use command line arguments to pass inputs in a single line while executing a program through the DOS command prompt or Linux terminal.
b) To use atoi function to convert a default string value argument to an integer value inside the main function in a program.
c) To use atof function to convert a default string value argument to a float value inside the main function in a program.

Text Book(s)

[1] Behrouz A. Forouzan and Richard F. Gilberg, "Computer Science A Structured Programming Approach Using C", CENGAGE Learning, Third Edition.

REFERENCE BOOKS

[1] Anil B. Chaudhuri, "Flowchart and Algorithm Basics: The Art of Programming", Mercury Learning & Information, 2020.

[2] R.G. Dromey, "How to Solve it By Computer", Prentice-Hall International Series in Computer Science,1982.

[3] YashwantKanetkar , "Let us C" , BPB Publications, 16th Edition 2017.

[4] Kernighan and Ritchie,"The C programming language", The (Ansi C Version), PHI, second edition.

[5] Paul J. Dietel and Harvey M. Deitel, "C: How to Program", Prentice Hall, 8th edition (Jan 19, 2021).

[6] K.R.Venugopal, Sundeep R. Prasad, "Mastering C", McGraw Hill, 2nd Edition, 2015.

E-RESOURCES AND OTHER DIGITAL MATERIAL

1] Computer Science and Engineering - Noc:problem Solving Through Programming in C. [online] https://nptel.ac.in/courses/106/105/106105171/
[2] Computer Science and Engineering - Noc:introduction To Programming in C. [online] https://-nptel.ac.in/courses/106/104/106104128/
[3] C For Everyone: Structured Programming. [online]https://www.coursera.org/learn/c-structured -programming
[4] Advanced C Programming CourseTim Academy-Jason Fedin. [online] https://www.udemy.com/-course/advanced-c-programming-course/

20ES1153
ENGINEERING WORKSHOP

Course Category:	Engineering Sciences	**Credits:**	1.5
Course Type:	Laboratory	**Lecture -Tutorial-Practice:**	0 - 0 - 3
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Understand the basic joints using wood and familiarize with various fundamental aspects of house wiring.
CO2	Prepare basic models using sheet metal and practice joining of metals using arc welding technique.
CO3	Familiarize with various manufacturing processes such as injection moulding and 3D printing
CO4	Understand the preparation of PCB
CO5	Understand simple IOT Applications using Arduino

Contribution of Course Outcomes towards achievement of Program Outcomes
(L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1			**M**		**H**									
CO2			**M**		**H**									
CO3			**M**		**H**									
CO4			**M**											
CO5					**L**									

COURSE CONTENT

PART-A

Carpentry:

a. Demonstration of Cross half lap and T joints. (1 class)
b. Demonstration of power tools.

Electrical Wiring:

a. Fundamentals of Electric wiring and practice of Series wiring. (1 class)

b. Practice of stair case wiring and connecting a fluorescent Tube.

Sheet metal & soldering:

a. Preparation of complete funnel using sheet metal and practice of soldering. (2 classes)

b. Preparation of a square box using sheet metal and practice of soldering.

Welding:

a. Preparation of Corner Joint using arc welding process. (1 class)

b. Preparation of "T" joint using arc welding process.

Manufacturing processes:

a. Preparation of a small plastic part using injection moulding process. (1 class)

b. Demonstration of manufacturing a simple model using 3D printing process.

Electronic Circuits:

1. **To prepare PCB for the given electronic circuit**
   a. To prepare the layout and printing it on copper clad board
   b. To etch and drill the holes on PCB (2 classes)

2. **To solder the components on the PCB prepared and test the circuit**
   a. To identify and solder the components on the PCB prepared
   b. To test the operation of the circuit.

Basic IOT:

1**. Demonstration of Arduino board**
   a. Demonstrate different components & pin configuration of Arduino
   b. To set up Arduino IDE for programming.

2.**To measure Temperature & Humidity**

a. Interfacing of temperature & humidity sensor with Arduino. (2 classes)

b. Execute the program on Arduino IDE & display the measured values.

3. **To measure Distance**

a. Interfacing of Ultrasonic Sensor with Arduino

b. Execute the program on Arduino IDE & display the measured value.

PART-B

GROUP ACTIVITY (4 classes)

Students must prepare a Working model / Assembly using the knowledge gained from the above trades.

TEXT BOOKS

[1] Kannaiah P. & Narayana K. C., "Manual on Workshop Practice", Scitech Publications, Chennai, 1999.

[2] Venkatachalapathy, V. S., "First year Engineering Workshop Practice", Ramalinga Publications, Madurai, 1999.

REFERENCE BOOKS

[1] Gopal, T.V., Kumar, T., and Murali, G., "A first course on workshop practice – Theory, Practice and Work Book", Suma Publications, Chennai, 2005

E-RESOURCES AND OTHER DIGITAL MATERIALL

1. https://dsceme.files.wordpress.com/2016/08/workshop-practice-manual-2016-17- 1.pdf
2. https://www.protosystech.com/rapid-prototyping.htm
3. https://www.arduino.cc/en/Tutorial/Foundations
4. https://www.tutorialspoint.com/arduino/

20MC1106
TECHNOLOGY AND SOCIETY

Course Category:	Institutional Core	**Credits:**	--
Course Type:	Mandatory Learning	**Lecture -Tutorial-Practice:**	1 - 0 - 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	100 -- 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Understand the origins of technology and its role in the history of human progress.
CO2	Know the Industrial Revolution and its impact on Society
CO3	Interpret the developments in various fields of technology till Twentieth Century.
CO4	Distinguish the impacts of Technology on the Environment and achievements of great scientists.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1												**L**
CO2							**M**					
CO3												**L**
CO4							**M**					

COURSE CONTENT

UNIT – I **(4 lectures)**

Introduction: Origins of technology, The Agriculture revolution, Technological contributions of ancient civilizations- Mesopotamians, Egyptians, Greeks, Romans, Indians and Chinese.

UNIT – II **(4 lectures)**

Industrial revolution: The social and political background, The technical background, Steam: The power behind the Indistrial Revolution, The revolution in Textile Industry, The Imapact of Indutrial Revolution on Society.

UNIT – III **(4 lectures)**

The Flowering of modern technology: Manufacturing Technologies, Prime Movers, Internal Combustion Engines, Production of Metals and Alloys, The Birth of Electrical Technology, Twentieth

Century: The Flowering of modern technology like information technology and biotechnology, and its implications on society.

UNIT – IV **(4 lectures)**

Technology, Science and Society: Impact of technology on society, The Impacts of Technology on the environment, Sustainable development.

Achievements of famous scientists:

(**World**): Einestein, Newton, Faraday, Graham Bell, Edison, S.Hawking.

(**India**): CV Raman, S.Chandrasekhar, Aryabhatta, Homi J Bhabha, Vikram Sarabhai, APJ Abdulkalan S.Ramanujan, M.Visweswarayya.

TEXT BOOKS

[1] Dr. R.V.G Menon, "Technology and Society", Pearson Education, 2011

REFERENCE BOOKS

[1] Quan-Haase, A., " Technology and Society: Inequality, Power, and Social Networks", Oxford University Press, 2013.

SECOND SEMESTER

20BS2101
LAPLACE TRANSFORMS AND INTEGRAL CALCULUS

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3 - 0 - 0
Prerequisites:	Vectors, Integration, Curve Tracing.	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Solve the Linear differential equations using Laplace Transforms.
CO2	Evaluate areas and volumes using Double, Triple Integrals.
CO3	Evaluate Grad, Div & Curl of scalar and vector point functions.
CO4	Convert Line Integrals to Area Integrals and Surface Integrals to Volume Integrals.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**H**	**M**			**L**							
CO2	**H**	**M**			**L**							
CO3	**H**	**M**			**L**							
CO4	**H**	**M**			**L**							

COURSE CONTENT

UNIT I

Laplace Transforms: Introduction, Definition, Conditions for the Existence, Transforms of Elementary functions, Properties of Laplace Transforms, Transforms of Periodic functions, Transforms of Derivatives, Transforms of Integrals, Multiplication by t^n, Division by 't', Inverse Transforms-Method of partial fractions, Other methods of finding Inverse Transform, Convolution Theorem, Unit Step and Unit Impulse functions.
Applications: Evaluation of Integrals, Solving Differential Equations by Laplace Transforms.

UNIT II

Integral Calculus: Double Integrals, Change of Order of Integration, Double Integrals in Polar Coordinates, Triple Integrals, Change of Variables.
Applications: Area enclosed by Plane Curves, Volumes of Solids.

UNIT III

Vector Differential Calculus: Scalar and Vector point functions, Del applied to Scalar point functions-Gradient, Del applied to Vector point functions, Physical interpretation of Divergence and Curl, Del applied twice to point functions, Del applied to products of point functions.

UNIT IV

Vector Integral Calculus: Integration of Vectors, Line Integral, Surface Integral, Green's Theorem in the plane, Stokes's Theorem, Volume Integral, Gauss Divergence Theorem, Irrotational Fields.

TEXT BOOK

B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2019.

REFERENCE BOOKS

[1].Erwin Kreyszig , Advanced Engineering Mathematics, John Wiley & Sons, 10th Edition, 2015.

[2].B.V.Ramana, Higher Engineering Mathematics,Tata MC Graw Hill, 1st Edition, 2007.
[3].N.P.Bali, Dr.Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications, 9th Edition, 2014.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1]. www.nptel videos.com/mathematics/ (Math Lectures from MIT,Stanford,IIT'S)

[2]. nptel.ac.in/courses/122104017

[3]. nptel.ac.in/courses/111105035

[4]. Engineering Mathematics Open Learning Project.
www.3.ul.ie/~mlc/support/Loughborough%20website/

20BS2102B
PHYSICS FOR ENGINEERS

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3 - 0 - 0
Prerequisites:	10 + 2 Level Physics	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Analyse and understand various types of crystal structures and their characterization.
CO2	Understand various concepts of acoustics and production & detection of Ultrasonics
CO3	Understand the classification, properties, preparation and applications of various engineering materials.
CO4	Understand the fabrication of nanomaterials and carbon Nanotubes.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**H**			**L**								
CO2	**H**											
CO3	**H**											
CO4	**H**											

COURSE CONTENT

UNIT – I : Crystallography and Characterization of materials

Crystallography: Introduction, Fundamental terms of crystallography, Types of crystals: Bravais lattices, Miller indices; Relation between inter planar distance and inter atomic distance, Crystal structures of materials: SC, BCC, FCC.

Characterization of materials: Introduction, diffraction of X-rays (Derivation for Bragg's law, Bragg's X-ray spectrometer), Determination of crystal structure by Powder crystal method.

Unit – II : Acoustics and Ultrasonics

Acoustics: Introduction, Classification of sound, Sound absorption: Absorption coefficient, Sabine's formula for reverberation time and its limitations, Factors effecting acoustics of building and their remedies and acoustic design of a hall.

Ultrasonics: Introduction,Properties of ultrasonic waves,Production of ultrasonic waves(Magnetostriction method and Piezo electric method), Detection of ultrasonic waves (Kundt's tube method,thermal method,sensitive flame method), Applications of ultrasonic waves.

UNIT – III : Engineering Materials

Dielectric Materials: Fundamental definitions, Types of Polarization: Electronic and Ionic polarizations, ferroelectric materials and their applications.

Superconductors: Introduction, Critical parameters, Meissner effect, Types of Superconductors, BCS theory, Cooper pairs, Applications of superconductors.

Composite materials: Introduction, classification, processing technique for composite materials (Fiber reinforced) and applications.

Shape memory alloys: Introduction, properties, commercial shape memory alloys (Ni-Ti and copper based alloys) and applications.

UNIT- IV: Nanotechnology

Nanotechnology: Basic concepts of Nanotechnology, Nanoscale, Introduction to nano materials, General properties of Nano materials, Significance of the nanoscale (Surface to volume ratio,Quantum confinement effect), Fabrication of nano materials: Plasma Arcing, Chemical vapour deposition, Characterization of nano materials: SEM, TEM. Carbon nano tubes: SWNT, MWNT, Formation of carbon nanotubes: Arc discharge, Laser ablation, Properties of carbon nano tubes, Applications of CNT's & Nanotechnology.

TEXT BOOKS

[1]. V. Rajendran, Materials science, Mc Graw Hill Publications, 4th Edition, 2014.
[2]. M.N. Avadhanulu & P.G. Kshirsagar, Engineering Physics, S. Chand publications, Revised Edition, 2014.
[3]. D.Thirupathi Naidu and M.Veeranjaneyulu, Engineering Physics, VGS Techno Series publications, 4th Revised Edition,2016.

REFERENCE BOOKS

[1]. S.O. Pillai, "Solid State Physics", New age international publishers, 7th Edition, 2015.
[2]. M.R. Srinivasan, "Engineering Physics", New age international publishers, First Edition, 2011.

E-RESOURCES AND OTHER DIGITAL MATERIAL

1. http://nptel.ac.in/courses/112106227/
2. https://ocw.mit.edu/courses/materials-science-and-engineering/3-60-symmetry-structure-and-tensor-properties-of-materials-fall-2005/video-lectures/introduction-to-crystallography-part-1/
3. https://architecture.mit.edu/subject/spring-2014-4431
4. http://freevideolectures.com/Course/3048/Physics-of-Materials/36
5. https://www.peterindia.net/NanoTechnologyResources.html

20ES2103B
PYTHON PROGRAMMING

Course Category:	Engineering Science	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3- 0 - 0
Prerequisites:	20ES1103Programming for Problem Solving 20ES1152Programming for ProblemSolving Laboratory	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Interpret the python syntax and semantics of control flow statements
CO2	Apply functions and modules in Python to solve a problem
CO3	Apply 3rd party packages for developing solutions for real time problems.
CO4	Implement the problems in terms of real world objects using OOPs concept.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**M**			**L**									**M**	**M**
CO2	**M**			**L**									**M**	**M**
CO3	**H**			**L**	**L**								**M**	**M**
CO4	**H**			**L**	**L**								**M**	**M**

COURSE CONTENT

UNIT I

Introduction: History-Origins of python, Features of Python- why choose python,what can I do with python, Installing, Python 2 & 3 installation on windows

Variables, Expressions & Statements: Variables, Variable names & keywords,Operators & operands, Expressions, Order of operations, Modulus Operator, StringOperations.

Conditional Execution: Boolean expressions, Logical operators, Conditionalexecution, Alternative execution, Chained conditionals, Nested conditionals,exceptions using try and except, Short circuit evaluation of logical expressions.

Iterations: The while statement, Infinite loops, “Infinite loops” and break,finishing iterations with continue, Definite loops using for.

UNIT II

Functions: Function Calls, Built-in functions, type conversion functions, randomnumbers, math functions, adding new functions, definition and uses, flow ofexecution, parameters & arguments, fruitful and void functions, why functions?, recursion, scope of a variable.

Modules: Packages small description about modularity, Third Party Packages, Abrief tour of standard library, command line arguments, Error output redirectionand program termination, String pattern matching, Mathematics, Internet Access,Dates & times, Data Compressions.

UNIT III

Lists: Syntactically, accessing element from list, slicing a list, lists are mutable sequences, deleting items in a list and deleting list, methods, searching

Dictionaries: Creating a dictionary, Dictionary operations, Dictionary methods,
Aliasing and copying

Tuples: Tuples are immutable, comparing tuples, Tuple assignment, Dictionaries and tuples, Multiple assignment with dictionaries, Using tuples as keys in dictionaries

Strings: A string is a sequence, Getting the length of a string using len, Traversal through a string with a loop, String slices, Strings are immutable, Looping and counting, The in operator, String comparison, string methods

Sets: Modifying a Set, removing items from set, set operations.

UNIT IV

Object Oriented Programming in Python: Python Classes, Methods, Constructors, Class variables & Instance Variables, Basic inheritance, Special methods, Data Hiding.

TEXT BOOKS:

[1]. VamsiKurama, "Python Programming: A Modern Approach", Pearson India, 2017.

[2]. Charles Severance, " Python for Informatics- Exploring Information", 1st edition Shroff Publishers, 2017.

REFERENCE BOOKS:

[1]. Mark Lutz,"Learning Python", 5th edition, Orielly, 2013.

[2]. Allen Downey "Think Python, How to Think Like a Computer Scientist",2nd edition, Green Tea Press, 2015.

[3]. W.Chun , "Core Python Programming", 2nd Edition, Prentice Hall, 2006.

[4]. Kenneth A. Lambert, "Introduction to Python", 1st edition, CengageLearning, 2011.

E-resources and other digital material:

[1]. Charles Severance: University of Michigan,Python for Everybody [COURSERA]. (05-01-2021), Available: https://www.coursera.org/

[2]. Prof. SudarshanIyengar, IIT Ropar, Prof. Yayati Gupta, IIIT Dharwad, The Joy Of Computing Using Python [NPTEL], (05-01-2021), Available:https://nptel.ac.in/courses/106/106/106106182/#

[3]. Charles Russell Sevarance, University of Michigan, Python for Everybody, 2019 https://www.coursera.org/learn/python

20ES2104F
ENGINEERING MECHANICS – II

Course Category:	Engineering Sciences	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3 - 0 - 0
Prerequisites:	Basic Mathematics, Physical Science, Engineering Mechanics-I (Statics)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Analyze the rectilinear motion of particles.
CO2	Analyze the curvilinear motion of particles.
CO3	Evaluate the moment of inertia of material bodies and analyze the fixed axis rotation of rigid bodies.
CO4	Analyze the plane motion of rigid bodies.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**H**	**M**	**M**											**M**
CO2	**H**	**M**	**M**											**M**
CO3	**H**	**M**	**M**											**M**
CO4	**H**	**H**	**H**											**H**

COURSE CONTENT

UNIT – I

Kinematics of Rectilinear Translation: Introduction, displacement, velocity and acceleration. Motion with Uniform and Variable acceleration.

Kinetics of Rectilinear Translation: Equations of rectilinear motion. Equations of Dynamic Equilibrium: D'Alembert's Principle. Work and Energy, Conservation of energy, Impulse and Momentum, Impact-Direct central Impact.

UNIT – II

Kinematics of Curvilinear Motion: Introduction, rectangular components of velocity and acceleration. Normal and Tangential acceleration, Motion of projectiles.

Kinetics of Curvilinear Motion: D'Alembert's Principle, and Work and Energy in curvilinear motion.

UNIT – III

Moment of Inertia of Material Bodies: Moment of inertia of a rigid body – Moment of inertia of slender bar, laminas (2D), Radius of gyration, Parallel axis theorem, Moment of inertia of 3D bodies- cone, cylinder, sphere and parallelepiped.

Kinematics of Rigid Body: Rotation: Linear and angular Velocity, linear and angular acceleration in uniformly accelerated rotation.

Kinetics of Rigid Body: Rotation: Equation of motion for a rigid body rotating about a fixed axis – Rotation under the action of a constant moment

UNIT – IV

Kinematics of Rigid Body: Plane motion: Concepts of relative velocity and Instantaneous center

Kinetics of Rigid Body: Plane motion: Equations of motion, Dynamic equilibrium of symmetrical rolling bodies.

TEXT BOOKS

[1] Engineering Mechanics by S. Timoshenko & D. H. Young, 4th Edition, 2007, McGraw Hill International Edition. (For Concepts and symbolic Problems).
[2] Engineering Mechanics Statics and dynamics by A. K. Tayal, 13th Edition, 2006, Umesh Publication, Delhi, (For numerical Problems using S.I.System of Units).

REFERENCE BOOKS

[1] Beer and Johnston, "Vector Mechanics for Engineers Statics and Dynamics",IIIrd edition, Tata McGraw Hill, 2010.
[2] SS Bhavikatti and KG Rajasekharappa, "Engineering Mechanics", IVth Edition, New Age International Private Limited, 2012
[3] K.Vijaya Kumar Reddy and J Suresh Kumar, " Singer's Engineering Mechanics Statics and Dynamics", IIIrd Edition BS Publications, 2010.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] http://emweb.unl.edu/
[2] https://nptel.ac.in/courses/122/104/122104015/

20HS2105
TECHNICAL ENGLISH AND COMMUNICATION SKILLS

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Theory	**Lecture -Tutorial-Practice:**	2 - 0 - 0
Prerequisites:	Basic understanding of the language skills viz Listening, Speaking, Reading and Writing, including Sentence construction abilities	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Develop administrative and professional compilations with felicity of expression
CO2	Demonstrate Proficiency in advanced reading and context oriented writing
CO3	Apply the elements of functional English with sustained understanding for authentic use of language in any given academic and/or professional environment
CO4	Execute tasks in Technical communication with competence

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1								**H**	**M**	**H**		
CO2								**H**	**M**	**H**		
CO3								**H**	**M**	**H**		
CO4								**H**	**M**	**H**		

COURSE CONTENT

UNIT I

Professional Writing Skills:-

- **Professional Letters**:
  Business, Complaint and Transmittal – Purpose, Style and format with special reference to Block Format and Modified Block Format
- **Paragraph and Essay Writing**:
  Linkers , Descriptive and Analytical with illustrations
- **Effective writing Practice**-
  Appropriateness. Brevity, clarity, cogency and coherence with guided and semi-controlled compilations including the use of Idiomatic expressions

UNIT II

Reading comprehension and Discourse development Skills

- **Analytical and critical reading** - critical, creative and lateral thinking- language and thinking – thinking process and language development.
- **Effective reading Strategies** - Skimming, Scanning, Eye span, fixation, taming Regression, and Issues and Challenges of Vocalization and sub-vocalization.
- **Context-oriented Dialogue/ Argument writing** - Extending Invitation, Reciprocation, Acceptance, Concurrence, Disagreeing without being disagreeable- Discourse/dialogue Development and identification of inconsistencies in pre-prepared dialogues

UNIT III

Vocabulary and Functional English

- **Vocabulary for Competitive examinations** (A list of 500 High frequency words) Synonyms, Antonyms, Matching Homonyms, Homophones and nearer words along with Root words
- **Verbal analogies**(Single Unit) – Synonym Relation, Antonym relation, Object- Operator relation, Object-Obstacle/obstruction relation, Sequence Relation, Place-Monument Relation, Science- area of activity relation, Profession- Tool relation, Gender relation, Diminutive relation, etc
- **Functional Grammar** with special reference to Tense, Concord, Articles, pronoun-referent, Prepositions, use of Gerund ,Parallelism, etc (A Representative collection of 100 sentences)

UNIT IV

Technical Communication skills:

- **Technical Proposal writing**- Characteristics, Proposal Superstructure, Checklist , Formal Proposal
- **Technical Vocabulary**- Basic explanations and Description
- **Technical Report writing**- Informational Reports and Feasibility Report- Types, Components, Style and Formats

TEXT BOOKS

[1] Martin Cutts, Oxford guide to Plain English, 7th Impression, Oxford University Press, 2011
[2] M. Ashraf Rizvi, Effective Technical Communication, Tata McGraw-Hill, New Delhi, 2005.
[3] John Langan, College Writing Skills, McGraw Hill, IX Edition, 2014.
[4] Eclectic Learning materials offered by the Department

REFERENCE BOOKS

[1] Randolph Quirk, Use of English, Longman, I Edition (1968) Reprinted 2004.
[2] Thomson A.J & A.V, Martinet, Practical English Grammar, III Edition, Oxford University Press,2001
[3] V.Sethi and P.V. Dhamija, A Course in Phonetics and Spoken English, II Edition, PHI, 2006

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] https://www.britishcouncil.org/english
[2] www.natcorp.ox.ac.uk/Wkshops/Materials/specialising.xml?ID=online
[3] https://www.uni-marburg.de/sprachenzentrum/selbstlernzentrum/.../apps_for_esl.pdf

20BS2151A
ENGINEERING PHYSICS LABORATORY

Course Category:	Institutional Core	**Credits:**	1.5
Course Type:	Lab	**Lecture -Tutorial-Practice:**	0 - 0 - 3
Prerequisites:	Physics for Engineers	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Use spectrometer and travelling microscope in various experiments
CO2	Determinethe V-I characteristicsof solar cell and photo celland appreciate the accuracy in measurements
CO3	Test optical components using principles of interference and diffraction of light

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1				H	M							
CO2				H								
CO3				H								

COURSE CONTENT

1. Melde's apparatus- Determine the frequency of tuning fork
2. Wedge method- Measurement of thickness of a foil
3. Variation of magnetic field along the axis of current-carrying circular coil
4. Fibre Optics- Determination of Numerical aperture
5. Photo cell-Study of V-I Characteristics, determination of work function
6. Solar cell –Determination of Fill Factor
7. Torsional Pendulum-Determination of Rigidity modulus
8. Determination of Dielectric constant of a sample
9. Diffraction grating-Measurement of wavelength of mercury source
10. Hall effect –Hall coefficient measurement
11. Compound pendulum-Determination of 'g'
12. Figure of merit of a galvanometer

TEXT BOOKS

[1] Madhusudhan Rao, "Engineering Physics Lab Manual", Isted., Scitech Publications, 2015
[2] Ramarao Sri, ChoudaryNityanand and Prasad Daruka, "Lab Manual of Engineering Physics"., Vth ed., Excell Books, 2010

E-RESOURCES

[1] http://plato.stanford.edu/entries/physics-experiment
[2] http://www.physicsclassroom.com/The-Laboratory
[3] http://facstaff.cbu.edu/~jvarrian/physlabs.html

VIRTUAL LAB REFERENCES

[1] http://vlab.amrita.edu/?sub=1&brch=201&sim=366&cnt=1
[2] http://vlab.amrita.edu/?sub=1&brch=195&sim=840&cnt=1
[3] http://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1

20ES2152B
PYTHON PROGRAMMING LAB

Course Category:	Engineering Science	**Credits:**	1.5
Course Type:	Lab	**Lecture -Tutorial-Practice:**	0 - 0 - 3
Prerequisites:	20ES1103 Programming for Problem Solving 20ES1152 Programming for Problem Solving Laboratory	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Implement python programming constructs to build small to large applications.
CO2	Implement the problems in terms of real-world objects using OOPs concept.
CO3	Evaluate and handle the errors during runtime involved in a program.
CO4	Extract and import packages for developing different solutions for real time problems.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**H**			**L**								**M**	**M**	**M**
CO2	**L**			**L**								**M**	**M**	**M**
CO3	**M**			**H**								**M**	**M**	**M**
CO4	**M**			**L**								**M**	**M**	**M**

COURSE CONTENT

Week 1: Fundamental programs

Running instructions in Interactive interpreter and a Python Script

Write a program to purposefully raise Indentation Error and Correct it

Week 2: Operations

Develop Python programs using basic operations in Python

Week 3 & 4: Conditional &Control Flow

Develop Python programs that makes use of conditional and control flow structures

Week 5: Functions

Develop Python programs using recursive and non-recursive functions

Week 6,7 & 8: Data Structures

Develop Python programs using suitable Data structures

Week 9: Modules

Illustrate installing packages via PIP and develop python programs using modules

Week 10 & 11:

Application oriented Case Studies

Week 12: Classes, Inheritance

Illustrate Class variables and instance variable

Develop Python programs to exemplify the concepts of inheritance and overloading.

TEXT BOOKS

[1]. VamsiKurama, "Python Programming: A Modern Approach", Pearson India, 2017.

[2]. Charles Severance, " Python for Informatics- Exploring Information", 1st edition Shroff Publishers, 2017.

REFERENCE BOOKS

[1]. Mark Lutz,"Learning Python", 5th edition, Orielly, 2013.

[2]. Allen Downey "Think Python, How to Think Like a Computer Scientist",2nd edition, Green Tea Press, 2015.

[3]. W.Chun , "Core Python Programming", 2nd Edition, Prentice Hall, 2006.

[4]. Kenneth A. Lambert, "Introduction to Python", 1st edition, CengageLearning, 2011.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1]. Charles Severance: University of Michigan,Python for Everybody [COURSERA]. (05-01-2021), Available: https://www.coursera.org/

[2]. Prof. SudarshanIyengar, IIT Ropar, Prof. Yayati Gupta, IIIT Dharwad, The Joy Of Computing Using Python [NPTEL], (05-01-2021), Available:https://nptel.ac.in/courses/106/106/106106182/#

[3]. Charles Russell Sevarance, University of Michigan, Python for Everybody, 2019 https://www.coursera.org/learn/python

20HS2153
TECHNICAL ENGLISH AND COMMUNICATION SKILLS LABORATORY

Course Category:	Institutional Core	**Credits:**	1.5
Course Type:	Practical	**Lecture -Tutorial-Practice:**	0 - 0 - 3
Prerequisites:	Basic understanding of the language skills viz Listening, Speaking, Reading and Writing, including Sentence construction abilities	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Develop active and authentic listening comprehension skills relevant for the professional world.
CO2	Execute web related(On-line) communication with felicity of expression
CO3	Apply relevant speech patterns including standard pronunciation
CO4	Demonstrate Proficiency in Interpersonal Communication with fluency and accuracy

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1				H								
CO2				H								
CO3				M								
CO4				M								

COURSE CONTENT

UNIT I

Listening Skills:

- **Exposure to structured and open talks**- Active listening, Appreciative listening, Biased listening, Critical listening Empathetic listening, Judgmental listening
- **Content-oriented Listening Skills** :
  Short Conversations- 5-10 minute duration- components, statistics, nominal and other references
- **Concept oriented/ purposive Listening skills**:
  Long Conversations- 10-30minute duration -
- **Problems in comprehension & retention** – Note-taking practice – Listening tests-
- **Overcoming Barriers to listening**: Physical & psychological – Steps to overcome them with demonstration and practice

Unit-II

Professional and On-line drafting skills:

- **Professional drafting skills** : Circular, Notice, Executive summary
- **E-mail etiquette**- Awareness with Illustrations and practice
- **Elements of Chat-room interaction**- courtesy, techniques of argumentation
- **Written Response to web-content**- conciseness with accountability
- **Data interpretation-** compiling analytical, comparative and critical observations by interpreting graphs, charts, etc.

UNIT III

Phonetics and Speech patterns:

- **Speech Mechanism** – Organs of speech and patterns of articulation of speech sounds.
- **Vowels, Consonants and Diphthongs**- Transcription using International Phonetic Alphabet
- **Word Stress and Rhythm-** practice
- **Intonation pattern practice**- Tones , Tone group boundaries and Tonal variations
- **Strong forms and weak forms in Connected speech** - Illustrations and Practice

UNIT IV

Interpersonal Spoken communication skills:

- **Fluency & accuracy in speech** –Improving self-expression
- **Listener oriented speaking** - Interpersonal Conversation- Manner and Temper
- **Developing persuasive speaking skills-** Role play
- **Overcoming Barriers to speaking** – Building self-confidence– through Conversation practice
- **Improving responding capacity** - Extempore speech practice

TEXT BOOKS

1. Garner, Bryan A, HBR Guide to Better Business Writing, Harvard Business Review Press, Boston, Massachusetts, 2013.
2. Exercises in Spoken English, Prepared by Department of Phonetics and Spoken English, CIEFL,(Currently English and Foreign Languages University) OUP, 21st Impression, 2003

REFERENCE BOOKS

[1] Randolph Quirk, Use of English, Longman, I Edition (1968) Reprinted 2004.
[2] Thomson A.J & A.V, Martinet, Practical English Grammar, III Edition, Oxford University Press,2001
[3] V.Sethi and P.V. Dhamija, A Course in Phonetics and Spoken English, II Edition, PHI, 2006

E-RESOURCES AND OTHER DIGITAL MATERIAL

1. ODll Language Learner's Software, Orell Techno Systems
2. Visionet Spears Digital Language Lab software Advance Pro
3. www.natcorp.ox.ac.uk, *British National Corpus*

20ES2154
COMPUTING AND PERIPHERALS LABORATORY

Course Category:	Engineering Sciences	**Credits:**	1
Course Type:	Laboratory	**Lecture -Tutorial-Practice:**	0 - 0 - 2
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Able to assemble a PC and install operating system and other software.
CO2	Able to trouble shoot hardware and software issues.
CO3	Able to configure network settings to connect to internet.
CO4	Able to createdocuments, presentations and spread sheets using office productivity tools.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**H**				**L**							**M**	**M**	**M**
CO2				**L**								**M**	**M**	**M**
CO3	**H**											**M**	**M**	**M**
CO4				**M**								**M**	**M**	**M**

COURSE CONTENT

PC Hardware/Software

Week 1 – Task 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

Week 1– Task 2: Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also, students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.

Week 2 – Task 1: Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

Week 2 – Task 2: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot with both windows and Linux. Lab instructors

should verify the installation and follow it up with a Viva

Week 3 – Task 1: Hardware Troubleshooting: Students have to be given a PC which does not boot due to improper assembly or defective peripherals. They should identify the problem and fix it to get the computer back to working condition. The work done should be verified by the instructor and followed up with a Viva

Week 3 – Task 2: Software Troubleshooting: Students have to be given a malfunctioning CPU due to system software problems. They should identify the problem and fix it to get the computer back to working condition. The work done should be verified by the instructor and followed up with a Viva.

Networks, Internet & World Wide Web

Week 4: Types of Network cables, connectors, crimping straight and crossover cables, identification of network devices (Hubs, Switches, Routers).
Week 5: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally, students should demonstrate, to the instructor, how to access the websites and email.
Week 6: Wifi router configuration, connecting to internet, Static/Dynamic IP address configuration, DNS, Gateway, Security configuration.

Productivity tools

LaTeX and Word

Week 7– Word Orientation: The mentor needs to give an overview of Microsoft (MS) office 2007/ equivalent (FOSS) tool word: Importance of MS office 2007/ equivalent (FOSS) tool Word as word Processors, Details of the three tasks and features that would be covered in word – Accessing, overview of components of toolbars, saving files, Using help and resources, rulers, format painter.
Week 8- Latex: Using LaTeX to create project certificate. Features to be covered: Formatting Fonts, Drop Cap, Applying Text effects, Using Character Spacing, Borders and Colours, Inserting Header and Footer, Using Date and Time option in both LaTeX.

Week 9: Creating project abstract Features to be covered: Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Excel

Week 10 - Task 1 - Excel Orientation: The mentor needs to tell the importance of MS office 2007/ equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the two tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.

Week 10 – Task2: Calculating GPA -Features to be covered: Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, LOOKUP/VLOOKUP, Sorting, Conditional formatting

Power Point or equivalent (FOSS) tool

Week 11– Task1: Students will be working on basic power point utilities and tools which help them create basic power point presentation. Topic covered during this week includes: PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in both LaTeX and Power point. Students will be given model power point presentation which needs to be

replicated (exactly how it's asked).
Week 12 - Task 3: Concentrating on the in and out of Microsoft power point. Helps them learn best practices in designing and preparing power point presentation. Topics covered during this week includes: - Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide master, notes etc), Inserting – Background, textures, Design Templates, Hidden slides.

TEXT BOOKS

REFERENCE BOOKS

1. LaTeX Companion – Leslie Lamport, PHI/Pearson.
2. Introduction to Computers, Peter Norton, 6/e Mc Graw Hill Publishers.
3. Upgrading and Repairing, PC's 18th e, Scott Muller QUE, Pearson Education
4. Comdex Information Technology course tool kit Vikas Gupta, WILEY Dreamtech
5. IT Essentials PC Hardware and Software Companion Guide Third Edition by David Anfinson and Ken Quamme. – CISCO Press, Pearson Education.
6. PC Hardware and A+ Handbook – Kate J. Chase PHI (Microsoft)

E-RESOURCES AND OTHER DIGITAL MATERIALL

1. https://dsceme.files.wordpress.com/2016/08/workshop-practice-manual-2016-17- 1.pdf
2. https://www.protosystech.com/rapid-prototyping.htm
3. https://www.arduino.cc/en/Tutorial/Foundations
4. https://www.tutorialspoint.com/arduino/

20MC2106
PROFESSIONAL ETHICS & PRACTICE

Course Category:	Mandatory Learning	**Credits:**	--
Course Type:	Theory	**Lecture -Tutorial-Practice:**	1 - 0 - 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	100 -- 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Know the moral autonomy and uses of ethical theories.
CO2	Understand Engineering as Experimentation
CO3	Understand about safety, risk and professional rights.
CO4	Know the ethics regarding Global issues related to Environment, Computers and weapon's development. Understand general principles of contracting.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1								**M**				
CO2								**M**				
CO3								**M**				
CO4								**M**				

COURSE CONTENT

UNIT I **(4 lectures)**

Engineering Ethics: Senses of 'Engineering Ethics' - variety of moral issues- types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory -Gilligan's theory - consensus and controversy - Models of Professional Roles -theories about right action - Self-interest - customs and religion- uses of ethical theories.

UNIT II **(4 lectures)**

Engineering as Social Experimentation: Engineering as experimentation – engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study

UNIT III **(4 lectures)**

Safety, Responsibilities and Rights: Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk – the three mile island and chernobyl case studies. Collegiality and loyalty – respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

UNIT IV **(4 lectures)**

Global Issues: Multinational corporations- Environmental ethics- computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership- sample code of Ethics (Specific to a particular Engineering Discipline).

General principles of contracts management : Indian contract act,1972 and amendments covering general principles of contracting.

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in engineering", McGraw Hill, New York (1996).
2. Govindarajan M, Natarajan S, Senthil Kumar V. S., "Engineering Ethics", Prentice Hall of India, New Delhi(2004).

REFERENCE BOOKS

[1] Baum, R.J. and Flores, A., "Ethical Problems in Engineering, Center for the studyof the Human Dimensions of Science and Technology", Rensellae Polytechnic Institute,Troy, New York, 335 pp. eds. (1978)

[2] Beabout, G.R., Wennemann, D.J. , "Applied Professional Ethics: A Developmental Approach for Use with Case Studies", University Press of America Lanham, MD, 175 pp (1994).

[3] Dutt (1994) Indian Contract Act, Eastern Law House.

THIRD SEMESTER

20BS3101D
MATHEMATICS FOR MECHANICAL ENGINEERS

Course Category:	Basic Science	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3 - 0- 0
Prerequisites:	20BS1101- Matrices and Differential calculus 20 BS 2101- Laplace Transforms and Integral Calculus	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Determine analytic, non-analytic functions and evaluate complex integrals.
CO2	Analyze Taylor, Laurent series and apply residue theorem for computing real definite integrals.
CO3	Solve algebraic and transcendental, system of equations and interpret theconcept of polynomial interpolation.
CO4	Evaluate the probabilities using distributions and estimate correlation,regression coefficients.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**H**	**M**		**L**									**L**	**L**
CO2	**H**	**M**		**L**									**M**	**M**
CO3	**H**	**M**		**L**	**L**								**M**	**M**
CO4	**H**	**M**		**M**	**L**								**M**	**M**

COURSE CONTENT

UNIT I

COMPLEX ANALYSIS:

Introduction, Continuity, Cauchy-Riemann equations, Analytic functions, Harmonic functions, Orthogonal systems, Applications to flow problems, Complex integration, Cauchy's integral theorem, Cauchy's integral formula.

UNIT II

Taylor's series, Laurent's series, Zeros and Singularities of an analytic function, Residue theorem, Calculation of Residues, Evaluation of real definite integrals: (i) Integration around the unit circle (ii) Integration around a small semi-circle, Bilinear transformation

UNIT III

NUMERICAL METHODS:

Solution of Algebraic and Transcendental equations with Newton - Raphson method, Solution of Simultaneous linear equations with Gauss - Seidel iterative method.

INTERPOLATION: Introduction, Finite Differences-Forward, Backward and Central differences, Symbolic Relations, Newton's interpolation formulae-forward and backward differences, Central difference interpolation formulae-Gauss's formulae, Interpolation with unequal intervals - Lagrange's and Newton's divided difference formulae.

UNIT IV

PROBABILITY DENSITIES: Continuous random variables – Normal distribution.

SAMPLING DISTRIBUTIONS: Populations and Samples – Sampling distribution of the mean (SD known) – Sampling distribution of the mean (SD unknown) – Sampling distribution of the variance.

STATISTICS: Method of Least Squares – Correlation – Regression.

TEXT BOOKS

[1] B. S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2019.

[2] Richard A. Johnson, "Probability and Statistics for Engineers", 8th Edition, Prentice Hall of India, 2011.

REFERENCE BOOKS

[1] Erwin Kreyzig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, 2015.

[2] R. K. Jain, S. R. K. Iyengar, "Advanced Engineering Mathematics", 5th Edition, Narosa Publishers, 2016.

[3] N. P. Bali, Manish Goyal, "A Text book of Engineering Mathematics", 9th Edition, Lakshmi Publications (P) Limited, 2016.

[4] H. K. Das, Er. Rajnish Verma, "Higher Engineering Mathematics", 3rd Revised Edition, S. Chand & Co., 2014.

[5] Rukmangadachari E, "Probability and Statistics", Pearson, 2012.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] Prof. Pranav Haridas, Kerala School of Mathematics, Complex Analysis, [English], Web Available: https://onlinecourses.nptel.ac.in/noc21_ma39/preview

[2] Prof. Ameeya Kumar Nayak, Prof. Sanjeev Kumar, IIT Roorkee, Numerical methods, [English],Web Available: https://onlinecourses.nptel.ac.in/noc21_ma45/preview

[3] Jeremy Orloff, Massachusetts Institute of Technology: MIT OpenCourseWare, Complex Variables with Applications, [English],Web Available: https://ocw.mit.edu.

[4] Henrik Schmidt, Massachusetts Institute of Technology: MIT OpenCourseWare, Introduction to Numerical Analysis for Engineering, [English], Web Available: https://ocw.mit.edu.

[5] Prof. A. Kannan, IIT Madras, Statistics for Experimentalists, [English], Web Available:https://freevideolectures.com/course/3467/statistics-for-experimentalists/2

20ME3302
MECHANICS OF MATERIALS

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3 - 0- 0
Prerequisites:	17ME1104AEngineering Mechanics - I 17ME1204 Engineering Mechanics - II	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Determine stresses and strains in structural members subjected to axial loading.
CO2	Construct Shear force and Bending moment diagrams for determinate beams and analyse the members subjected to bending& torsion.
CO3	Estimate the deflections of determinate beams and safe load on columns.
CO4	Solve plane stress problems and evaluate the stresses in thin cylindrical and spherical vessels.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**H**	**L**	**L**											**M**
CO2	**M**	**H**	**L**											**M**
CO3	**M**	**H**	**L**											**M**
CO4	**M**	**H**	**L**											**M**

COURSE CONTENT

UNIT I

TENSION, COMPRESSION AND SHEAR : Introduction, Concepts of Normal Stress and Strain, Stress-Strain Diagrams, Elasticity and Plasticity, Linear Elasticity and Hooke's Law, Poisson's Ratio, Shear Stress and Strain, Allowable Stresses and Allowable Loads. Numerical problems on Change in length of axially loaded members. Change in length for a tapered bar under axial loading.

TORSION: Introduction, Torsional deformations of Circular Bar, Circular bars of linearly elastic materials, Transmission of power by circular shafts.

UNIT II

STATICALLY DETERMINATE BEAMS: Introduction, Types of Beams, Loads and Reactions, Shear Force and Bending Moments, Relationships between Load, Shear Force and Bending Moment, Shear Force and Bending Moment Diagrams.

BENDING STRESSES IN STATICALLY DETERMINATE BEAMS: Introduction, Pure bending, Bending stress Equation, Design of beams for bending stresses

UNIT III

DEFLECTIONS OF STATICALLY DETERMINATE BEAMS: Introduction, Differential Equations of the Deflection Curve, Deflections by Integration of the BendingMoment Equation, Macaulay's Method.

COLUMNS: Introduction,Buckling and Stability, Columns with Pinned ends, Columns with other support conditions, Limitations of Euler's Formula, Rankine's Formula.

UNIT IV

ANALYSIS OF PLANE STRESS: Introduction, Plane Stress, Principal Stresses and Maximum Shear Stress.Mohr's Circle for Plane Stress.

THIN CYLINDRICAL AND SPHERICAL PRESSURE VESSELS:

Introduction,Stressesinthincylindrical and spherical pressure vessels subjected to internal pressure. Effect of internal pressure on the dimensions of the thin cylindrical and spherical pressure vessels.

TEXT BOOKS

[1] James M. Gere and Barry J.Goodno, "Mechanics of Materials", Eighth edition, CENGAGE Learning, 2013

[2] R.K.Bansal, "Strength of Materials"Sixth edition,Laxmi Publishers, 2017

REFERENCE BOOKS

[1] Dr. Sadhu Singh,"Strength of Materials", Ninth edition, Khanna Publishers, 2007.

[2] R.K. Rajput,"Strength of Materials",First Edition,S.Chand& Company, 2006.

[3] S.S.Rattan, "Strength of Materials", Third Edition,Tata McGraw Hill Education Private Limited, 2017

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] Prof. M.S. Sivakumar, IIT Madras, Strength of material, [English], Web Available: http://nptel.ac.in/courses/112106141/

[2] Dr. Satish C Sharma, IIT Roorkee, Strength of material, [English], Web Available: http://nptel.ac.in/courses/112107146/

[3] Dr. S. P. Harsha, IIT Roorkee, Strength of material, [English], Video Available: http://nptel.ac.in/courses/112107147/

20ME3303
BASIC THERMODYNAMICS

Course Category:	Programme Core	**Credits:**	4
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3 - 0- 0
Prerequisites:	Engineering Physics and Chemistry	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Illustrate the basic concepts of thermodynamics and can distinguish work and heat forms of energy
CO2	Apply first of law of thermodynamics to flow and non-flow processes and thermodynamic systems
CO3	Apply the second law of thermodynamics to systems and understand the concept of entropy, exergy and irreversibility
CO4	Evaluate the properties of steam, gas mixtures and analyse steam and air cycles

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**H**	**M**	**L**										**M**	
CO2	**M**	**H**	**H**										**M**	
CO3	**M**	**H**	**M**										**M**	
CO4	**M**	**H**	**M**										**M**	

COURSE CONTENT

UNIT I

FUNDAMENTAL CONCEPTS AND DEFINITIONS: Thermodynamic system, type of systems Macroscopic and microscopic points of view, properties and state of a substance, Thermodynamic equilibrium and Quasistatic Process, thermodynamic path, cycle, Zerothlaw of thermodynamics, Temperatures scales

WORK AND HEAT: Ideal gas equation, equation of state, Work transfer, pdV-work and heat transfer in various Quasistatic processes, flow work, path function and point function, heat transfer-A path function, comparison of heat and work.

UNIT II

FIRST LAW FOR NON-FLOW SYSTEMS: Joule Experiment in establishing First law of thermodynamics, First law of thermodynamics for a system undergoing a cycle and for a change in state of system, Energy –a property of a system, internal energy and enthalpy, constant volume and constant pressure specific heats and their relation to internal energy and enthalpy of ideal gases.

FIRST LAW FOR FLOW SYSTEMS: Control mass and control volume, first law of thermodynamics for a control volume, steady flow energy equation and application to engineering equipment.

UNIT III

SECOND LAW OF THERMODYNAMICS: Cyclic heat engines and Refrigerators, Kevin Planks and Clausius statements, Equivalence of Kevin Planks and Clausius statements, Carnot cycle, Carnot theorem and its corollary, absolute thermodynamic temperature scale, efficiency of reversible heat engine and COP of reversed heat engine, Causes of irreversibility, Concept of Exergy and irreversibility (Theory).

ENTROPY: Clausius Theorem, property of entropy, Inequality of Clausius, Entropy change in irreversible process, Entropy principle, Problems on Entropy change and entropy generation in system during change of state, T-ds relations.

UNIT IV

PROPERTIES OF GAS MIXTURES: Properties of mixture of gases-Dalton`s law of Partial Pressures, Internal Energy, enthalpy and specific heats of gas mixtures and Entropy ofgas mixtures

PURE SUBSTANCES: P-v, P-T, T-s and h-s diagrams for a pure substance, Triple point, Critical point, Dryness fraction, Steam tables, problems using steam tables and Mollier chart.

VAPOUR AND AIR POWER CYCLES: Ideal Rankine cycle, Otto cycle, Diesel cycle,Dual cycle

TEXT BOOKS

[1].P. K. Nag, “Engineering Thermodynamics” 6thedition, Tata Mc Graw Hill Education Private Limited, 2017.

[2] Yunus A. Cengel M. and Michael A. Boles, “Thermodynamics – An Engineering Approach”, 8th edition, McGrawHill Education (India) Private Limited, 2014.

REFERENCE BOOKS

[1] G.J.Van Wylen & Sonntag, “Fundamentals of Classical Thermodynamics”, 4th Edition, Wiley publication 2005.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] www.learnthermo.com/tutorials.php
[2] www.khanacademy.org/science/physics/ thermodynamics
[3] www.courseera.org/learn/ thermodynamics -intro
[4] www.edx.org/course/thermodynamics -iitbombayx-me209-1x-1
[5] http://nptel.ac.in/courses/112106141
[6] http://nptel.ac.in/courses/112108148

Note: Steam tables are permitted in internal and external examinations

20ME3304
MANUFACTURING PROCESSES

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3 - 0- 0
Prerequisites:	-Nil-	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Explain the Methodology of the casting processes.
CO2	Distinguish various casting methods and their applications.
CO3	Categorize various Bulk Deformation and Sheet Metal operations.
CO4	Illustrate various Welding processes with applications.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**H**	**H**	**H**											**L**
CO2	**H**	**L**	**L**											**L**
CO3	**H**	**L**	**L**											**L**
CO4	**H**	**H**	**H**											**L**

COURSE CONTENT

UNIT I

CASTING PROCESSES:

INTRODUCTION TO MANUFACTURING PROCESSES: Selecting manufacturing processes, Sand casting – General method, pattern: types, materials and allowances. Molding Sand - Materials, Equipment, Preparation, Control and Testing. Types of Cores, Gating system and Risers: Types, Functions and Design (Numerical). Solidification process and time estimation (Numerical). Classification of Furnace: Constructional Features, Working Principle and Zones of Cupola Furnace, Electric Furnace – Arc. Advantages, Limitations and Applications.

UNIT II

SPECIAL CASTING METHODS: Permanent Mold Casting, Die Casting: Hot chamber die casting- Cold chamber die casting, Centrifugal Casting: True Centrifugal Casting, Semi-centrifugal Casting and Centrifuging.

INVESTMENT CASTING: Shell Mold Casting - CO2 Process and Continuous Casting, Casting defects: Causes, Remedies and Testing. Advantages, Limitations and Applications.

UNIT III

BULK DEFORMATION PROCESSES: Fundamentals, Hot and Cold working of metals - Rolling- Forging- Extrusion -Tube Making, and Wire Drawing. High Energy Rate Forming Processes: Explosive Forming, Electro Hydraulic Forming, Electro Magnetic Forming.

SHEET METAL WORKING OPERATIONS: Introduction, Sheet metal Blanking - Punching operations. Clearance and Shear as applied to Punching/Blanking operations, Elastic recovery in bending operation, Simple related problems.

UNIT IV

WELDING PROCESSES:

Fundamentals and classification of welding, Gas welding Processes: Working Principle of Oxy-acetylene Gas Welding, Arc Welding: TIG – MIG - Submerged, Arc length, Arc blow, Duty cycle. Resistance Welding: Principles of Resistance Welding- Types: Butt Welding, Spot Welding, Seam Welding. Advantages, Limitations and Applications.

SPECIAL WELDING PROCESSES: Electron beam welding, Thermit Welding, Electro slag welding, Laser beam welding, Under Water Welding. Brazing & Soldering, Welding defects: Causes and Remedies, Weld design-simple problems. Advantages, Limitations and Applications.

TEXT BOOKS

[1] [1]. Manufacturing Technology by P.N. Rao,Vol.1, Edition-3, 2009, TMH.
[2] Production Technology (Manufacturing Processes) by P.C. Sharma, 2007, S. Chand Publishers.
[3] Principles of Metal Casting by Heine, Loper, Rosenthal.33rd Reprint, 2008, TMH.
[4] Manufacturing Engineering and Technology by Kalpakjain. S, 2006, Pearson Education Indian Edition.

REFERENCE BOOKS

[1] Welding and welding Technology by Richard.L.Little,1973, McGraw Hill.
[2] Workshop Technology Vol.1 by S.K.Hazra Chowdary, Khanna publishers.
[3] A course in Work shop technology Vol-1 by V.S.Raghuwamshi, 2007, Dhanpatrai & sons.
[4] Mechanical Metallurgy by George. E. Dieter, SI Metric Edition 2000, McGraw Hills.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] http://nptel.iitm.ac.in
[2] http://www.egr.msu.edu
[3] http://www.engr.sjsu.edu
[4] http://mechatronic.me.hfu.edu.tw
[5] http://web.iitd.ac.in

20ME3305
KINEMATICS OF MACHINES

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3 - 0- 0
Prerequisites:	20ES1104C Engineering Mecahnics- I 20ES2104F Engineering Mecahnics- II 20ES1105 Engg. Graphics	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Distinguish different Mechanisms and determine velocity of links using Instantaneous Centre Method
CO2	Evaluate velocity and acceleration of various links in a Mechanism
CO3	Apply the analytical techniques for Synthesis of Mechanisms & Develop cam profiles
CO4	Illustrate the concepts of toothed gearing and gear trains

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**H**	**L**	**M**											**L**
CO2	**L**	**H**	**M**											**M**
CO3	**M**	**M**	**H**											**M**
CO4	**M**	**H**	**M**											**M**

COURSE CONTENT

UNIT I

INTRODUCTION : Mechanisms and machines, Rigid and resistant bodies, Link, Kinematic pair, Types of joints, Constrained motions, Degrees of Freedom, Mobility - Kutzbach criterion -

Gruebler's equation - Grashoff's law, Classifications of Kinematic pairs, kinematic-chain,

Linkage, mechanism and structure, Classification of mechanisms, Inversions of Mechanism- Four - bar chain, Single Slider - Crank Chain, Double – Slider Crank Chain.

INSTANTANEOUS CENTRE: Notation, Number of Instantaneous centres, Kennedy's theorem, Locating Instantaneous centres, Angular velocity by Instantaneous centre Method for simple mechanisms (Four bar and Slider - Crank Mechanism).

UNIT II

VELOCITY AND ACCELERATION ANALYSIS: Introduction, Absolute and Relative Motion, Vectors, Addition and subtraction of Vectors, Motion of a Link, Velocity and Acceleration, Angular velocity and Angular acceleration of Links: Four bar Mechanism, Velocity and Acceleration of Intermediate and offset points. Velocity and acceleration of Slider - Crank Mechanism, Coriolis acceleration of Crank and Slotted Lever Mechanism.

UNIT III

KINEMATIC SYNTHESIS : Stages of synthesis-Concepts of type, Numberand dimensional synthesis - Tasks of dimensional synthesis, Concepts of function generation, Rigid body guidance and path generation, Freudenstein equation for function generation using three precision points for four bar mechanism. (3 precision points only).

CAMS: Introduction, Classification of cams and followers, Terminology and definitions, Displacement diagrams – Uniform velocity, simple harmonic and uniform acceleration motions, Graphical synthesis of cam profile limited to reciprocating, radial & offset follower. (Knife Edge and Roller Followers).

UNIT IV

GEARS: Introduction, Classification of gears, Gear terminology, Law of Gearing, Velocity of Sliding, Forms of Teeth- Cycloidal Profile Teeth, Involute Profile Teeth,Comparison of Cycloidal and Involute tooth forms. Path of contact, Arc of contact, Number of pairs of Teeth in contact, Concept of Interference in Involute Gears. Minimum number of Teeth in Involute Gears,

GEAR TRAINS: Introduction, simple Gear Train, Compound Gear Train, Reverted Gear train, Planetary or Epicyclic Gear Train, Analysis of Epicyclic Gear Train using Tabular method only.

TEXT BOOKS

[1] S.S.Rattan, Theory of Machines, 4th Edition, 2014, TMH.
[2] Amitabha Ghosh and Asok Kumar Mallik, Theory of Mechanisms and Machines, 3rd Edition,2006 East West Press

REFERENCE BOOKS

[1] C S Sharma and Kamlesh Purohit, Theory of Mechanisms and Machines, Prentice Hall of India.
[2] Dr. R. K. Bansal & Dr. J. S. Brar, Theory of Machines 4th Edition, 2009, Lakshmi publications Robert L.Norton, Design of Machinery, 6rd Edition, 2019, McGraw-Hill Education.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] http://nptel.iitg.ernet.in/Mech_Engg/IIT%20Delhi/Kinematics%20of%20Machines.htm
[2] http://freevideolectures.com/Course/2359/Kinematics-of-Machines
[3] http://www.rapidmaniac.com/search/relevant/All/solution-manual-kinematics-and- dynamics-of machines

20ME3351
SOLID MODELLING LABORATORY

Course Category:	Programme Core	**Credits:**	1.5
Course Type:	Laboratory	**Lecture -Tutorial-Practice:**	0 - 0- 3
Prerequisites:	Engineering Graphics	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Construct sketches in a modelling software
CO2	Create part model of machine components
CO3	Develop 2D sketches for machine components
CO4	Translate geometric models to other file formats.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1			**M**		**H**									**H**
CO2			**M**		**H**									**H**
CO3			**M**		**H**									**H**
CO4			**M**		**H**									**H**

COURSE CONTENT

Lab Exercises:

1. Construction of 2D sketches.
2. Modelling of simple machine components.
3. Assembly of Machine components.
4. Orthographic views of the assembled components.
5. Solid modelling of real components
6. Exporting the files to other file formats
7. Group assignment topics

i. Part drawing & Assembly of Screw jack
ii. Part drawing & Assembly of Stuffing Box
iii. Part drawing of Marine engine connecting rod end
iv. Part drawing & Assembly of Single tool post
v. Part drawing & Assembly of Socket and spigot joint
vi. Part drawing & Assembly of Foot-step bearing
vii. Develop various types of GI pipe fittings
viii. Develop double strap diamond butt joint

TEXT BOOKS

[1] Pro/Engineer Wildfire 5.0 by Roger Toogood, Jack Zecher, SDC Publications.
[2] Machine Drawing by K.L Narayana, P.Kannaiah, K.Venkata Reddy, Publisher: New Age International

REFERENCE BOOKS

[1] Parametric Modeling with Pro/ENGINEER Wildfire 5.0
[2] Parametric Modeling with Creo Parametric 1.0

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] http://www.proetutorials.com/
[2] http://learningexchange.ptc.com/tutorials/by_sub_product/p tc-creo-elements-pro-pro-engineer/sub_product_id:1
[3] http://www.eng-tips.com/viewthread.cfm?qid=48209
[4] https://catiatutor.com/
[5] www.v5train.com

NPTEL Video references:
[1] https://www.youtube.com/watch?v=c2VtgkfZ2BQ
[2] https://www.youtube.com/watch?v=hjgGxl4Yk_M
[3] https://www.youtube.com/watch?v=xsKtzWBZ5FY
[4] https://www.youtube.com/watch?v=rIFeKNzm4gE
[5] https://www.youtube.com/watch?v=uCdypjnnKto
[6] https://www.youtube.com/watch?v=YIzwA_Wlj_M

20ME3352
MANUFACTURING PROCESS LABORATORY

Course Category:	Programme Core	**Credits:**	1.5
Course Type:	Laboratory	**Lecture -Tutorial-Practice:**	0 - 0- 3
Prerequisites :	Basic Workshop Lab Manufacturing processes	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Develop various joints using fitting.
CO2	Create various welding joints.
CO3	Build various sand casting moulds.
CO4	Construct various models using 3D printing.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1			**H**	**H**										**L**
CO2			**H**	**H**										**L**
CO3			**M**	**H**										**L**
CO4			**H**	**H**										**M**

COURSE CONTENT

I. FITTING:
To make the following joints
a. Half round Joint
b. Stepped Joint
c. Dovetail Joint

II .WELDING:
To make the following welding joints
a. To make Lap Joint using Oxy Acetylene Gas welding
b. To make 'T'– Joint using MIG welding
c. To make Spot joint (Door Handle) using Resistance welding

III. FOUNDRY:
To make the following sand moulds
a. Single piece pattern (Stepped Rectangular Block)
b. Two piece pattern (Step Cone Pulley)
c. Two piece pattern (Double end pipe flange)

IV. 3D PRINTING:
To make the following 3D print models
a. Bolt &Nut
b. Screw feeder
c. Gear wheel

IV. PROJECT:

To prepare a metal Casting (Automobile component) – Group assignment

TEXT BOOKS

[1] S.K.HajraChowdary, A.K. HajraChowdary, NirjharRoy,"Elements of WorkshopTechnology, Vol.I".Media Promoters and Publishers Pvt.Ltd, Mumbai,Scitech Publications, Chennai, 2013

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] https://www.youtube.com/watch?v=OwzHpVE_S4I
[2] https://www.youtube.com/watch?v=1nXbYXj7Xos
[3] https://www.youtube.com/watch?v=0tOfaQ9pOGU
[4] https://www.youtube.com/watch?v=wQaytFTckGU
[5] https://3d-p.eu/wp-content/uploads/2018/08/IO3_3DP-courseware_EN.pdf

20ME3353
COMPUTATIONAL METHODS LABORATORY

Course Category:	Programme Core	**Credits:**	1.5
Course Type:	Laboratory	**Lecture -Tutorial-Practice:**	0 - 0- 3
Prerequisites:	20BS1101 Matrices and Differential Calculus 17MA1301/D Mathematics For Mechanical Engineers 20ES1104C Engineering Mechanics-I	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Illustrate basic commands in MATLAB and perform matrix Operations
CO2	Evaluate linear equations, Numerical integration and ODE using FDM
CO3	Intercept Engineering Mechanics and Strength of Materials Problems
CO4	Solve Thermal Engineering Problems

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**H**												**H**	
CO2	**H**	**M**											**H**	
CO3	**L**	**H**			**H**								**H**	
CO4	**L**	**H**		**M**	**H**								**H**	

COURSE CONTENT

List of Experiments:

1. Basic MATLB Commands, functions and plot commands

2. Scalars, vectors and Matrix Operations

3. Solution of System of Linear Equations

4. Numerical Integration and Differentiation

5. Solution of ODE problem using FDM Method

6. Solution to simple Engineering Mechanics Problem

7. Solution to simple Vibration Problem

8. Solution to simple Strength of Materials Problem

9. Solution to simple Thermodynamics Problem

10. Solution to simple Fluid Dynamics Problem

11. Solution to simple Heat Transfer Problem

TEXT BOOKS & REFERENCE BOOKS

[1] Solving Mechanical Engineering Problems with MATLAB, 2nd Edition, Simin Nasseri,Linus Learning (2022)
[2] MATLAB programming by Y.Kirani Singh &B.B.Chaudhuri. PHI Publications (2010).
[3] Getting started with MATLAB -a quick reference for scientists & engineers by RudraPratap. Oxford University Press (2009).
[4] An introduction to programming and numerical methods in MATLAB by S.R.Otto, J.P.Denier. Springer Publications (2007)
[5] Ordinary and Partial Differential Equation Routines in C, C++, FORTRAN, Java, Maple,and MATLAB by H.J. Lee, W.E. Schiesser.
[6] Graphics and GUIs with MATLAB, Third Edition (Graphics & GUIs with MATLAB)3rd Edition by O. Thomas Holland, Patrick Marchand.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] http://www.math.ucsd.edu/~bdriver/21d-s99/matlab-primer.html
[2] http://www.mathworks.in/academia/student_center/tutorials/ launchpad.html
[3] http://www.cyclismo.org/tutorial/matlab/
[4] http://www.mathworks.com/matlabcentral/fileexchange?s_cid=wiki_matlab_17
[5] http://www.youtube.com/user/matlab?feature=results_mai
[6] http://www.youtube.com/watch?v=DPLBPdux6bs

20TP3106
LOGIC & REASONING

Course Category:	Institutional Core	**Credits:**	1
Course Type:	Learning by Doing	**Lecture -Tutorial-Practice:**	0- 0- 2
Prerequisites:	-Nil-	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	100 0 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Think reason logically in any critical situation
CO2	Analyze given information to find correct solution
CO3	To reduce the mistakes in day to day activities in practical life
CO4	Develop time management skills by approaching different shortcut methods
CO5	Use mathematical based reasoning to make decisions
CO6	Apply logical thinking to solve problems and puzzles in qualifying exams for companies and inother competitive exams

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**M**													
CO2				**M**										
CO3				**M**										
CO4	**M**													
CO5	**M**													
CO6	**L**													

COURSE CONTENT

UNIT I :

1. Series Completion,
2. Coding-Decoding,
3. Blood Relation Blood,
4. Puzzles test

UNIT II:

1. Direction sense test,
2. Logical Venn diagrams,
3. Number test, ranking test,
4. Mathematical operations

UNIT III:

1. Arithmetical Reasoning,
2. Inserting missing character,
3. Syllogism.

UNIT IV: Non – Verbal:

1. Water images,
2. Mirror images,
3. Paper folding,
4. Paper cutting,
5. Embedded Figures,
6. Dot situation,
7. Cubes & Dice

TEXT BOOKS

[1] R. S. Aggarwal, " Verbal and non-verbal reasoning", Revised Edition, S Chand publication, 2017ISBN:81-219-0551-6

20MC3107B
INDIAN CONSTITUTION

Course Category:	Mandatory Course	**Credits:**	0
Course Type:	Theory	**Lecture -Tutorial-Practice:**	2 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	100 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Know the fundamental law of the land.
CO2	Identify how fundamental rights are protected
CO3	Perceive the structure and formation of the Indian Government System
CO4	Enumerate when and how an emergency can be imposed and what are the consequences.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1								**L**						
CO2								**M**						
CO3								**M**						
CO4								**L**						

COURSE CONTENT

UNIT I

INTRODUCTION TO CONSTITUTION OF INDIA: Meaning of the Constitution Law and Constitutionalism, Historical perspective of constitution of India, Salient features of Constitution of India.

UNIT II

FUNDAMENTAL RIGHTS: Scheme of the fundamental rights, scheme of the fundamental right to equality, scheme of the fundamental right to certain freedoms under Article 19, scope of the right of life and personal liberty under Article 21, writs jurisdiction.

UNIT III

NATURE OF THE INDIAN CONSTITUTION: Federal structure and distribution of legislative and financial powers between the Union and states

PARLIAMENTARY FORM OF GOVERNMENT IN INDIA: The Constitution powers and status of the President of India, Amendment of the Constitutional powers and Procedure, Historical Perspectives of the constitutional amendments in India

LOCAL SELF GOVERNMENT: Constitutional Scheme in India

UNIT IV

EMERGENCY PROVISIONS: National Emergency, President rule, financial emergency

TEXT BOOKS

[1] Dr. J.N. Pandey, Constitutional Law of India published by Central law Agency, Allahabad, Edition 2018

REFERENCE BOOKS

[1] V.N Shukla's, Constitution of India Eastern Book Company, Lucknow.
[2] M.P. jain, Indian Constitution Law, Wadhwa and Company, Nagpur.
[3] D.D. basu, Constitution of India, Wadhwa and Company, Nagpur E-resources and other digital material

FOURTH SEMESTER

20ME4101F
FLUID MECHANICS AND HYDRAULIC MACHINES

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3 - 0- 0
Prerequisites:	20ES1104C 20ES2104F	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Evaluate the fluid properties and analyze the fluid flow
CO2	Apply the knowledge of fluid dynamics for flow analysis and analyze the losses in pipes
CO3	Apply the momentum principles in impact of jets & analyze the flow in boundary layer
CO4	Analyze the performance of hydraulic turbines and pumps

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**H**	**M**	**L**										**L**	
CO2	**M**	**H**	**M**										**M**	
CO3	**M**	**H**	**L**										**M**	
CO4	**M**	**H**	**M**										**M**	

COURSE CONTENT

UNIT I

FLUID PROPERTIES AND FLUID STATICS: Density, Specific weight, Specific gravity, Viscosity, Surface Tension, Capillarity, Types of Fluids, Vapour pressure, Compressibility, Pressure and its measurement (Treatment limited to Manometers).

FLUID KINAMETICS: Stream line, path line, streak line, stream tube, classification of flows, one and three dimensional continuity equation.

UNIT II

FLUID DYNAMICS: Surface and Body forces - Euler's equation of motion and Bernoulli's equation from Euler's equation, applications of Bernoulli's equation, Momentum equation.

INTRODUCTION TO PIPE FLOW: Reynold's experiment, Darcy-Weisbach equation, Minor Losses in pipes (Treatment limited to explanation), flow through pipes in series and parallel, Hydraulic gradient and total energy lines.

UNIT III

BOUNDARY LAYER CONCEPTS: Definition, Displacement Thickness, Momentum Thickness, Energy Thickness, Drag and Lift (Treatment limited to concept only).

INTRODUCTION TO TURBO MACHINERY: Review of moment equation, Impact of jet of water on various configurations and derivation of force applied by jet in all applications, Introduction to velocity triangles and applications.

UNIT IV

HYDRAULIC TURBINES: Classification of turbines, Pelton wheel construction and working principle, Francis turbine and Kaplan turbines details discussion, Heads, Efficiencies and Performance of turbines.

HYDRAULIC PUMPS: Classification of pumps with definition, Working Principles and derivations of Centrifugal and Reciprocating pumps.

TEXT BOOKS

[1] R.K.Bansal, "Fluid Mechanics & Hydraulic Machines" Ninth Edition, Laxmi Publications, 2009.

[2] Robert W. Fox , Alan T. McDonald and Philip J. "Fluid Mechanics" Eighth edition, Wiley Publishers.

REFERENCE BOOKS

[1] P.N.Modi & S.M. Seth.," Hydraulics and Fluid Mechanics", Second Edition, Standard Book House, 2005.

[2] S K Som, Gautam Biswas and Suman Chakraborty, "Introduction to Fluid Mechanics & Fluid Machines", Third Edition, Tata McGraw-Hill education Private Limited, 2011.

[3] R.K. Rajput, "Fluid Mechanics & Hydraulic Machines", Fourth Edition, S.Chand & Company, 2008.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1]] Prof. S.K. Som, IIT Kharagpur, Fluid Mechanics & Hydraulic Machines, [English], Web Available: http://nptel.ac.in/courses/112105171/

[2] Prop. Gowtham Biswas, IIT Kharagpur, Fluid Mechanics & Hydraulic Machines, [English], WebAvailable: http://nptel.ac.in/courses/112104118/

[3] Fluid Mechanics & Hydraulic Machines, [English], Web Available: http://www.efluids.com/

20ES 4102A
ELECTRICAL AND ELECTRONICS ENGINEERING

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3 - 0- 0
Prerequisites:	Nil	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Explain the fundamentals of electric circuits and DC Machines.
CO2	Interpret the operation of three phase induction motors and Identify measuring Instruments
CO3	Illustrate the operation of various diodes and rectifier circuits.
CO4	Demonstrate the operation of various transistor configurations and FET's.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**H**	**H**		**M**									**L**	**L**
CO2		**L**		**M**									**L**	**L**
CO3			**H**	**M**									**L**	**L**
CO4			**H**	**M**									**L**	**L**

COURSE CONTENT

UNIT I

DC and AC circuits: Kirchoffs laws, simple circuits -Alternating current - waveforms - RMS - Average values of sine wave-simple R-L-C- circuits, Power factor, 3-phase balanced circuits.

D.C. Machines: DC Machines: Principle of operation, construction and Classification of DC Machines, EMF and Torque equations, Characteristics of shunt generator, Characteristics of series and shuntmotors, Principle of starters-3 point starter.

UNIT II

Three Phase Induction Motor: Principle of Rotating Magnetic Field, construction and Principle of Operation of 3-φ I.M, Torque Equation, Torque-Slip Characteristics of 3-φ I.M.

Measuring Instruments: Classification of instruments, Principles and operation of moving - coil and moving-iron instruments. – Dynamometer –type watt meter.

UNIT III

Semiconductor Diode Characteristics : Conductors, Semiconductors, Insulators, p-n Junction as a Diode, The Volt Ampere Characteristics (Forward bias & Reverse bias), Zener diode, characteristics of Zener diode(Forward bias & Reverse bias), Zener diode as a regulator,

Rectifier circuits: Operation of Half wave Rectifier, Full wave Rectifier, Bridge rectifier, Ripple factor derivation (HWR, FWR, Bridge rectifier), Capacitor filter for full wave rectifier, Compare Half wave, Full wave, Bridge rectifiers.

UNIT IV

Transistor Characteristics: Operation of the Junction Transistor (PNP & NPN), Transistor as an Amplifier, Transistor as a switch, The Common Base Configuration, The Common Emitter Configuration, The Common Collector Configuration, Comparison of CB, CE, CC configurations.

Filed Effect Transistors: Construction and Characteristics of JFETs, Transfer Characteristics, Depletion-type MOSFET and Enhancement-type MOSFET, Uni-Junction Transistor.

TEXT BOOKS

[1 I.J.Nagrath and Kothari, "Theory and problems of Basic Electrical Engineering",Prentice- Hall of India Pvt. Ltd.

[2] V.K.Mehta and Rohit Mehta,Principles of electrical machines,S.Chand publications

[3] S. Salivahanan, N. Suresh Kumar, A. Vallava Raj " Electronic Devices and circuits" Second edition, Tata McGraw Hill Publication.

REFERENCE BOOKS

[1] Basic Electrical Engineering by Nagsarkar, Sukhija, Oxford Publications, 2nd edition.

[2] BL Theraja, A text book of Electrical Technology, Nirja

[3] Jacob Millman, Christos C. Halkias and Chetan D Parekh, "Integrated Electronics", 2nd Edition, Tata McGraw Hill Publication, 2012.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] http://nptel.ac.in/courses.php?branch=eee

[2] http://en.wikipedeia.org/wiki/electrical

[3] https://embeddedengineers.files.wordpress.com/2015/09/electronic-devices-and-circuits-by-salivahanan.pdf

[4] http://www.nptelvideos.in/2012/12/basic-electronics-drchitralekha-mahanta.html

20ME4303
MACHINE DYNAMICS

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3 - 0- 0
Prerequisites:	17ME1104A Engineering Mechanics - I 17ME1204 Engineering Mechanics - II	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Comprehend the concepts of energy fluctuations in fly wheels.
CO2	Modulate the speed of governors and appraise gyroscopic effects on vehicles.
CO3	Accomplish balancing of rotating and reciprocating masses.
CO4	Evaluate natural frequency for longitudinal, transverse and torsional vibrations.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**M**	**H**	**L**											**M**
CO2	**M**	**H**	**L**											**M**
CO3	**M**	**H**	**H**											**M**
CO4	**M**	**H**	**L**											**M**

COURSE CONTENT

UNIT I

TURNING MOMENT DIAGRAMS: Introduction, Single - cylinder double – acting steam engine, Single - cylinder four stroke engine, Multi-cylinder engine, Fluctuation of energy, determination of maximum fluctuation of energy, coefficient of fluctuation of energy.

FLY WHEELS: Introduction, Coefficient of fluctuation of speed, energy stored in fly wheel.

UNIT II

GOVERNORS: Introduction, Watt Governor, Porter Governor, Hartnell Governor, Sensitiveness of a Governor, Hunting, Isochronism, Stability.

GYROSCOPES: Angular Velocity, Angular Acceleration, Gyroscopic Torque, Gyroscopic Effect on Air-planes and Naval Ships

UNIT III

BALANCING OF ROTATING SYSTEMS: Introduction, Static balancing, Dynamic balancing, Transferring of a Force from one plane to another, Balancing of Several Masses in Different planes.

BALANCING OF RECIPROCATING SYSTEMS: Primary balancing only.

UNIT IV

UNDAMPED FREE VIBRATIONS:

LONGITUDINAL VIBRATION: Introduction, Definitions, Types of vibrations, Basic features of vibrating systems, Degree of freedom, free longitudinal vibrations.

TRANSVERSE VIBRATION: Single concreted load, shaft carrying several loads, whirling of shafts.

TORSIONAL VIBRATION: Single rotor systems and two rotor systems, Torsionally equivalent shafts.

TEXT BOOKS

[1] S.S.Rattan, "Theory of Machines", Fifth edition, McGraw Hill Education (India) Private Limited, 2014

[2] Dr.R.K.Bansal & Dr.J.S.Brar," Theory of Machines", Fourth edition, Laxmi Publications (P) Limited, 2009.

REFERENCE BOOKS

[1] R.S.Khurmi & J.K.Guptha," Theory of Machines", 14th Edition, S.Chand & Company, 2006.

[2] V.P.Singh,"Mechanical vibrations", Second Edition, Dhanpat Rai & Co (P) Limited, 2009.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] Video in web: http://nptel.ac.in/courses/112104114/

[2] Video in web: https://youtu.be/OlZXxPVpmBs

[3] Notes in web: http://www.vssut.ac.in/lecture_notes/lecture1429901026.pdf

20ME4304
ENGINEERING METALLURGY

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3 - 0- 0
Prerequisites:	17PH1102/1202 Engineering Physics 17CH1102/17CH1202) Engineering Chemistry	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Recognize the importance and concept of materials and solid solutions.
CO2	Exemplify the phase diagrams and TTT diagrams of steels.
CO3	Classify the heat treatment processes and strengthening mechanisms.
CO4	Recognize the principles of powder metallurgy and manufacturing methods of different types of composites.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**H**		**M**										**L**	**L**
CO2	**H**		**M**										**L**	**L**
CO3	**H**		**M**										**L**	**L**
CO4	**H**		**M**										**L**	**L**

COURSE CONTENT

UNIT I

INTRODUCTION TO MATERIAL SCIENCE: Material Science, Classification of materials, Requirement and selection of materials, Mechanical properties of materials.

INTRODUCTION TO CRYSTALLOGRAPHY: Space Lattice, Unit Cell, Bravais Lattices, Coordination number, Atomic Packing Factor for SCC, BCC and FCC, Crystal imperfections, Crystal deformation- Slip and Twinning.

SOLID SOLUTIONS: Introduction, Substitutional solid solutions, Ordered Substitutional solid solutions, Disordered Substitutional solid solutions, Hume Rothery's rule, Interstitial solid solution.

UNIT II

PHASE DIAGRAMS: Binary phase diagrams – Phase rule – one component system, two component system, isomorphous, eutectic, eutectoid, peritectic and peritectoid systems, Fe-Fe_3C equilibrium diagram.

TTT Diagrams: TTT diagrams for eutectoid, hypo and hyper eutectoid steels.

UNIT III

HEAT TREATMENT PROCESSES: Annealing, normalizing, hardening, tempering, austempering, martempering, flame Hardening, Induction Hardening & Chemical hardening techniques, hardenability concept and experimental determination.

STRENGTHENING MECHANISMS: Strain hardening, solid solution strengthening, grain refinement, dispersion strengthening.

UNIT IV

POWDER METALLURGY: Powder metallurgy process, preparation of powders, Characteristics of metal powders - Particle shape, Fineness, Particle size distribution, Flow rate, Chemical properties, Compressibility, Apparent density, Sintering ability, mixing, compacting, sintering, Applications of Powder Metallurgy.

COMPOSITE MATERIALS: Introduction, Classification of composites, Characteristics of Composite Materials, Advantages and Dis-advantages of composite materials, applications of composite materials, various methods of component manufacture of composites – Hand Lay-up method, Resin transfer moulding, Filament winding process, and continuous pultrusion process.

TEXT BOOKS

[1] Kodgirie .V.D and Kodgirie.S.V, "Material Science and Metallurgy", Thirty-seventh Edition, Everest House Publication, 2015.

[2] Raghavan.V, " Material Science and Metallurgy" ,Fifth Edition, PHI Learning Pvt Limited,2013

REFERENCE BOOKS

[1] Avener , "Introduction to Physical Metallurgy", Second Edition, Tata McGraw hill Education (India) Pvt Limited,1997.

[2] [2] Rajput R. K,"Material Science and Engineering", Fourth Edition, S.K.kataria& Sons,2009.

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[1] Prof.R.N.Ghosh, IIT Kharagpur, Solidification Binary Alloys, Iron-Carbon Phase Diagram,[English]WebAvailable:
https://www.youtube.com/results?search_query=prof.r.n+ghosh+lecturers

[2] Prof.S.K.Gupta, IIT Delhi, Phase Diagrams, Crystal imperfections [English] Web Available: https://www.youtube.com/watch?v=x3n9ht-eRfg

20HS4105
UNIVERSAL HUMAN VALUES

Course Category:	Humanities and Social Sciences	**Credits:**	3
Course Type:	Mandatory course (suggested by AICTE)	**Lecture -Tutorial-Practice:**	3 - 0- 0
Prerequisites:	None. Universal Human Values 1 desirable.	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	50 50 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Familiarize themselves and their surroundings (family, society and nature).
CO2	Handle problems with sustainable solutions, while keeping human relationships and human nature in mind.
CO3	Exhibit critical ability and become sensitive to their commitment towards their understanding of human values, human relationship and human society.
CO4	Apply what they have learnt to their own self in different day-to-day settings in real life.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1						**L**		**H**	**M**			**M**		
CO2						**L**		**H**	**M**			**M**		
CO3						**M**		**H**	**M**			**M**		
CO4						**M**		**H**	**M**			**M**		

COURSE CONTENT

UNIT I

Course introduction, need, basic guidelines, content and process for value education:

Part-1: Purpose and motivation for the course, recapitulation from UHV-I, Self-exploration: what is it?, its content and process, 'Natural acceptance' and experiential validation- as the process for self-exploration. Continuous Happiness and Prosperity – A look at basic Human Aspirations.

Part-2: Right understanding, Relationship and Physical Facility – 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.
(Practice sessions are to be included to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking).

UNIT II

Understanding Harmony in the Human Being – Harmony in Myself:

Part-1: Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' – happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
Part-2: Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.
(Practice sessions are to be included to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs. dealing with disease).

UNIT III

Understanding Harmony in the Family and Society – Harmony in Human-Human Relationship:

Part-1: Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.
Part-2: Understanding the harmony in the society (society being an extension of family); Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society–Undivided Society, Universal Order–from family to world family.
(Practice sessions are to be included to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education, etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives).

UNIT IV

Part-1:Understanding Harmony in Nature & Existence – Whole existence as Coexistence: 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 of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

Part-2: 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, c) ability to identify and develop appropriate technologies and management patterns for above production systems, 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.

(Part-1: Practice sessions are to be included to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology, etc. Part-2: Practice exercises and case studies are to be taken up in practice (tutorial) sessions eg. to discuss the conduct as an engineer or scientist, etc.)

TEXT BOOKS

[1] Human values and professional ethics, R. R. Gaur, R. Sangal and G. P. Bagaria, Excel Books Private Limited, New Delhi (2010).

REFERENCE BOOKS

[1] Jeevan Vidya: Ek Parichaya, A. Nagaraj, Jeevan Vidya Prakashan, Amarkantak (1999).
[2] Human Values, A. N. Tripathi, New Age International Publishers, New Delhi (2004).
[3] The Story of Stuff: The impact of overconsumption on the planet, our communities, and our health and how we can make it better, Annie Leonard, Free Press, New York (2010).
[4] The story of my experiments with truth: Mahatma Gandhi Autobiography, Mohandas Karamchand Gandhi, B. N. Publishing (2008).
[5] Small is beautiful: A study of economics as if people mattered, E. F. Schumacher, Vintage Books, London (1993).
[6] Slow is beautiful: New Visions of Community, Cecile Andrews, New Society Publishers, Canada (2006).
[7] Economy of Permanence, J. C. Kumarappa, Sarva-Seva-Sangh Prakashan, Varanasi (2017).
[8] Bharat Mein Angreji Raj, Pandit Sunderlal, Prabhath Prakashan, Delhi (2018).
[9] Rediscovering India, Dharampal, Society for Integrated Development of Himilayas (2003).
[10] Hind Swaraj or Indian Home Rule, M. K. Gandhi, Navajivan Publishing House, Ahmedabad (1909).
[11] India Wins Freedom: The Complete Version, Maulana Abul Kalam Azad, Orient Blackswan (1988).
[12] The Life of Vivekananda and the Universal gospel, Romain Rolland, Advaitha Ashrama, India (2010).
[13] Mahatma Gandhi: The Man who become one with the Universal Being, Romain Rolland, Srishti Publishers & Distributors, New Delhi (2002).

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] AICTE – SIP Youtube Channel:
https://www.youtube.com/channel/UCo8MpJB_aaVwB4LWLAx6AhQ
[2] AICTE – UHV Teaching Learning Material:
https://fdp-si.aicte-india.org/download.php#1

20ES4351
ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

Course Category:	Programme Core	**Credits:**	1.5
Course Type:	Lab	**Lecture -Tutorial-Practice:**	0 – 0 - 3
Prerequisites:	20 ES 4102-Electrical & Electronics Engg	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Analyze the parameters of electrical network.
CO2	Interpret the performance of DC and AC machines.
CO3	Illustrate the operation of various diodes and rectifier circuits
CO4	Inspect the operation of various transistor configurations and FET's

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1			**M**	**H**									**L**	**L**
CO2			**M**	**H**									**L**	**L**
CO3			**H**	**M**									**L**	**L**
CO4			**H**	**M**									**L**	**L**

COURSE CONTENT

ELECTRICAL ENGINEERING

1. Verification of KCL & KVL
2. Determination of parameters of choke coil
3. Measurement of low and medium resistance.
4. Open circuit characteristics of separately excited generator
5. Brake test on DC shunt motor
6. Brake test on 3-phase Induction motor

ELECTRONIC ENGINEERING

1. Obtain the V-I characteristics of PN junction diode.
2. Obtain the V-I characteristics of Zener diode.
3. Verify the output waveform for full wave bridge rectifier and calculate ripple factor. Compare the result with theoretical value.
4. Obtain the input and output characteristics of transistor in CB configuration.
5. Obtain the input and output characteristics of transistor in CE configuration.
6. Obtain the drain and transfer characteristics of JFET.

TEXT BOOKS

[1 I.J.Nagrath and Kothari, "Theory and problems of Basic Electrical Engineering",Prentice- Hall of India Pvt. Ltd.

[2] V.K.Mehta and Rohit Mehta, Principles of electrical machines, S.Chand publications

[3] S. Salivahanan, N. Suresh Kumar, A. Vallava Raj, Electronic Devices and circuits Second edition, Tata McGraw Hill Publication.

REFERENCE BOOKS

[1] Nagsarkar, Sukhija, Basic Electrical Engineering, Oxford Publications, 2nd edition.
[2] BL Theraja, A text book of Electrical Technology, Nirja
[3] Jacob Millman, Christos C. Halkias and Chetan D Parekh, "Integrated Electronics", 2nd Edition, Tata McGraw Hill Publication, 2012.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1 http://nptel.ac.in/courses.php?branch=eee

[2] http://en.wikipedeia.org/wiki/electrical

[3] https://embeddedengineers.files.wordpress.com/2015/09/electronic-devices-and-circuits-by-salivahanan.pdf

20ME4352
STRENGTH OF MATERIALS & FLUID MECHANICS LABORATORY

Course Category:	Programme Core	**Credits:**	1.5
Course Type:	Lab	**Lecture -Tutorial-Practice:**	0 – 0 - 3
Prerequisites:	20 ES 1104 C Engineering Mechanics-I 20 ES 2104 F Engineering Mechanics-II 20 ME 3102 Mechanics of Materials 20 ME 4101 Fluid Mechanics & Hydraulic Machines	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Determine Young's modulus using UTM
CO2	Evaluate hardness, Tensile, compressive, shear and impact strengths as per IS code of Practice
CO3	Measure the rigidity modulus by conducting torsion test on Mild Steel
CO4	Determine the coefficient of discharge for Venturimeter, orifice, orificemeter & mouthpiece
CO5	Determine the Friction factor for a given pipe
CO6	Evaluate and analyse the characteristics of Centrifugal pumps, Reciprocating Pumps and Gear pumps

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**M**	**H**		**H**					**M**					**M**
CO2	**M**	**H**		**H**					**M**					**M**
CO3	**M**	**H**		**H**					**M**					**M**
CO4	**M**	**H**		**H**					**M**				**H**	
CO5	**M**	**H**		**H**					**M**				**H**	

CO6	**M**	**H**		**H**					**M**				**H**	

COURSE CONTENT

Strength of Materials Lab:

1. Determination of Young's modulus for Mild Steel by conducting Tension test on UTM
2. Load vs Deflection - Determination of Young's modulus on cantilever beam and simply supported beam.
3. Compression test- Determination of compressive strength of Concrete block or Wood
4. (a) Rockwell Hardness test - Determination of Hardness Number for different metal specimens such as Mild steel, cast iron, Brass, Aluminum (b) Brinnell's Hardness Test
5. Impact Test - (a) Charpy and (b) lzod: Determination of impact strength of Mild steel and cast iron specimens
6. Torsion test - Determination of Modulus of Rigidity of the material.
7. Double shear Test - Determination of shear strength of Mild steel specimens

Fluid Mechanics Lab:

1. Orifice / mouthpiece - Determination of coefficient of discharge
2. Venturimeter / Orifice meter - Determination of coefficient of discharge
3. Pipe friction - Determination of friction factor and size of roughness of a given pipe.
4. Single - stage centrifugal pump - To draw the operating characteristics of the pump and to determine the designed discharge and designed head from it.
5. Single - acting reciprocating pump - To draw the operating characteristic curves at constant speed and determination of efficiency.
6. Gear pump - To draw the operating characteristic curves and determination of overall efficiency

TEXT BOOKS

[1 James M. Gere and Barry J. Goodno, "Mechanics of Materials" Seventh edition, CENGAGE Learning, 2019

[2] R.K.Bansal, "Fluid Mechanics & Hydraulic Machines" Fifth edition, Laxmi Publishers, 2020.

REFERENCE BOOKS

[1] Dr. Sadhu Singh,"Strength of Materials"
Ninth edition, Khanna Publishers, 2017.

[2] P.N.Modi & S.M. Seth.,"Hydraulics and Fluid Mechanics",
Second edition, Standard Book House, 2015.

20ES4353
PROGRAMMABLE LOGIC CONTROLLERS LAB

Course Category:	Programme Core	**Credits:**	1.5
Course Type:	Lab	**Lecture -Tutorial-Practice:**	0 – 0 - 3
Prerequisites:	Nil	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Demonstrate knowledge of basic ladder logic instructions like timers, counters etc. used to program PLCs.
CO2	Apply PLC ladder programming for simple industrial processes.
CO3	Analyze the performance of PLC based systems.
CO4	Make use of various vendors PLCs to perform experiments as individual or team

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**H**		**M**		**M**									**M**
CO2	**H**		**M**		**M**									**M**
CO3	**H**		**M**		**M**									**M**
CO4	**H**		**M**		**M**									**M**

COURSE CONTENT

List of experiments:

1.Implementation of logic gates using PLC ladder diagram (LD)

2. Implementation of timers using PLC

3. Implementation of counters using PLC

4. Positive and negative edge detection in PLC

5. Level control using PLC

6. Pressure control using PLC

7. Temperature control using PLC

8. Motor speed control using PLC

9. Automation of material handling system using PLC

10. Automatic pneumatic stamping machine using PLC

11. Automatic drilling system using PLC

12. Elevator control using PLC

20TP4106
ENGLISH FOR PROFESSIONALS

Course Category:	Programme Core	**Credits:**	1
Course Type:	PRACTICE	**Lecture -Tutorial-Practice:**	0 – 0 - 2
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	How conversations are made
CO2	Usage of grammar
CO3	Etiquettes and manners
CO4	Speaking Skills

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1												**H**		
CO2												**H**		
CO3												**H**		
CO4												**H**		

COURSE CONTENT

Unit I

1. Beginners, Functional, Situational Conversations

Introduction

-Importance of spoken English in the placements and Group Discussion

Beginners Conversation

-Self Introduction-Introducing Self

-Introducing each other in a team (Pair Activity)

Functional Conversation

-Seeking Permission from Seniors Teachers and other superiors (Team Activity)

-Asking Direction-Direction from stranger or from Helpline

-Making Requests-Requests for borrowing books, applications, or any other help from office staff in college

or outside.
2. Just a minute:
-Give a topic and ask the student to talk impromptu.
-To present the topic in a structured manner.

Unit II

3. Structuring and forming sentences
-Structure of mother tongue and pit falls in translation to English.
-Formation of sentences in English
4. Errors in Usage
-Difficulty in right usage of words.
-Difficulty in Pronunciation-Phonetic differences in mother tongue and English –areas to improve.
-Idioms and Phrase –Frequently used Idiom and Phrases which help to enhance the quality of presentation and make the presentation meaningful.
-Meaning of frequently used Idioms and Phrases.

Unit III

4. Introduction to different ways of speaking.
-Elocution, Debate and Extempore
-Principles of Elocution and its challenges practice in session.
-Principles of Debates and its challenges –practice session.
-Principles of Extempore - its pitfalls- practice sessions.

Unit IV

5. Etiquette
-Need of Etiquette in Social arena
-Dining Etiquette
-Social Etiquette in conversation -formal and informal gathering.
-Book a table etc.
6. Versant Test
-Mode of versant Test,
-Aim of the test and various methods it follows
-Practice session.

- **Being a training program, the scope is broader and the pedagogue is not limited to the reference mentioned ibid above.**

REFERENCE BOOKS

[1] Kamalesh Sadanand, "A Spoken English", VOL 1&2; Orient BlackSwan, Second Edition,2014.
[2] "Communicative English"; Pearson; 2010

20ME4607
ROBOTICS LAB

Course Category:	Skill oriented course	**Credits:**	2
Course Type:	Laboratory	**Lecture -Tutorial-Practice:**	1 – 0 - 2
Prerequisites:	Nil	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Create a Robotic work cell using a Modelling & Simulation software
CO2	Simulate the Robotic work cycle using a Modelling & Simulation software
CO3	Use Material Handling Robot to perform Pick and Place Operation
CO4	Use Arc Welding Robot to perform Seam Welding task.
CO5	Use Spot Welding Robot to join parts through Spot Weld Joint.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**H**		**M**		**M**									**M**
CO2	**H**		**M**		**M**									**M**
CO3	**M**		**M**		**M**									**M**
CO4	**M**		**M**		**M**									**M**
CO5	**M**		**M**		**M**									**M**

COURSE CONTENT

Lab Exercises:

1. Introduction to a Robotic Modelling and Simulation software for learning Offline Programming.
2. Create a work cell environment for a Material Handling robot to perform Pick and Place Job.
3. Learn the use of a Teach Pendant for Online Programming of a Robotic manipulator

4. Create a program and execute Pick and Place Operation using Material Handling Robot
5. Create a program and produce a Seam Weld Joint using Arc Welding Robot.
6. Create a program and produce a Spot Weld Joint using Spot Welding Robot.

TEXT BOOKS

[1] Industrial Robotics by Mikell P. Groover, H Weiss, Roger N Nagel, Nicholas G Odrey, Ashish Dutta, McGraw Hill Education.
[2] Robotic Engineering by Richard D. Klafter, Prentice Hall, Tata Hc Graw-Hill, 1995. 3rd Edition.
[3] Robotics and Control - R K Mittal and I J Nagrath, TMH Publications

REFERENCE BOOKS

[1] Introduction to Robotics – John J. Craig, Addison Wesley,3rd Edition
[2] Robotics – K. S. Fu, Gonzalez & Lee, Tata Hc Graw-Hill, 1995. 3rd Edition.

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[1] https://library.abb.com/
[2] https://www.fronius.com/en-in/india/
[3] http://www.obara.co.jp/en/product/spot/controller.html

20MC4108A
ENVIRONMENTAL STUDIES

Course Category:	Environmental Studies	**Credits:**	
Course Type:	Theory	**Lecture -Tutorial-Practice:**	2 - 0- 0
Prerequisites:	Consciousness of Environment	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40+40+17+3 --- 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Identify various factors causing degradation of natural resource and control measures
CO2	Identify various ecosystems and need for biodiversity
CO3	Interpret the problems related to environmental pollution and its Management
CO4	Apply the information and technology to analyze social issues

Contribution of Course Outcomes towards achievement of Program Outcomes
(L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**L**							**L**					**L**	
CO2		**L**	**L**							**L**			**L**	
CO3				**L**	**L**							**L**	**L**	
CO4						**L**	**L**	**L**					**L**	

COURSE CONTENT

UNIT I

The Multidisciplinary Nature of Environmental StudiesDefinition, scope and importanceNeed for public awareness.

Natural Resources :

Renewable and Non-renewable Resources: Natural resources and associated problems.

(a)Forest resources: Use and over-exploitation, deforestation. Timber extraction, mining, dams and their effects on forests and tribal people.
(b)Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
(c)Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.
(d)Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.
(e)Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.
(f)Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT II
Ecosystems

Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: (a) Forest ecosystem (b)Grassland ecosystem (c)Desert ecosystem
(d)Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and Its Conservation

Introduction, definition: genetic, species and ecosystem diversity. Biogeographically classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT III
Environmental Pollution

Definition ,Causes, effects and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards
Solid waste management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.
Disaster management: Floods, earthquake, cyclone and landslides.

UNIT IV
Social Issues and the Environment:

From unsustainable to sustainable development. Urban problems related to energy.
Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns.
Environmental ethics Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation.Consumerism and waste products.
Environment Protection Act

Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife

Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation.

Public awareness

Human Population and the Environment,Population growth, variation among nations, Population explosion—Family Welfare Programme.

Environment and human health

Human rights, Value education,HIV/AIDS,Women and Child Welfare,Role of Information Technology in environment and human health.

Field Work/ Case Studies

Visit to a local area to document environmental assets—river/forest/grassland/hill/ mountain. Visit to a local polluted site—Urban/Rural/Industrial/Agricultural.Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Self-Study: Water resources, Threats to biodiversity, Solid waste management, Role of Information Technology in environment and human health.

TEXT BOOKS

[1]. ErachBharucha. 2004, Environmental Studies for undergraduate courses, University Grants Commission, New Delhi, BharatiVidyapeeth Institute of Environment Education and Research.

REFERENCE BOOKS

[1] AnjaneyuluY. Introduction to Environmental sciences, B S Publications PVT Ltd, Hyderabad

[2] Anjireddy.M Environmental science & Technology, BS Publications PVT Ltd, Hyderabad.

[3] Benny Joseph, 2005, Environmental Studies, The Tata McGraw- Hill publishing company limited, New Delhi.

[4] Principles of Environmental Science. &Engg. P.VenuGopalaRao, 2006, Prentice-Hall of India Pvt. Ltd., New Delhi.

[5] Ecological and Environmental Studies – Santosh Kumar Garg, RajeswariGarg (or) RajaniGarg, 2006, Khanna Publishers, New Delhi.

[6] Essentials of Environmental Studies, Kurian Joseph & R Nagendran, Pearson Education publishers, 2005.

[7] A.K Dee – Environmental Chemistry, New Age India Publications.

[8] BharuchaErach- Biodiversity of India, Mapin Publishing Pvt.Ltd..

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[1]. ErachBharucha. 2004, Environmental Studies for undergraduate courses, University Grants Commission, New Delhi, BharatiVidyapeeth Institute of Environment Education and Research.https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf

[2]. NPTEL Courses - Environmental Studies By Dr.Tushar Banerjee | Devi AhilyaViswavidyalaya, Indore.

FIFTH SEMESTER

20ME5301
APPLIED THERMODYNAMICS

Course Category: Programme Core
Course Type : Theory
Prerequisites:
20ME3303 Basic Thermodynamics
Total Marks: 100

Credits: 3
Lecture/Tutorial/ Practice: 3/0/ 0
Continuous Evaluation: 30
Semester end Evaluation: 70

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: ***Analyze*** the performance of I.C engines and Steam nozzles

CO2: ***Illustrate*** the working of steam turbines, condensers and ***analyze*** their performance

CO3: ***Analyze*** the performance of air compressors and gas turbines

CO4: ***Apply*** thermodynamic principles in refrigeration and air conditioning systems

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSOII
CO1	L	M											M	
CO2	L	M											M	
CO3	L	M											M	
CO4	L	M											M	

(L-Low, M-Medium, H-High)

UNIT - I

I.C.ENGINES: Working of 4-S and 2-S spark and compression ignition engines, Comparison of SI and CI engines and 4 stroke and 2 stroke engines, Applications of IC Engines, Mean effective pressure, IP, BP, Thermal and Mechanical efficiencies.

STEAM NOZZLES: Types of nozzles, isentropic flow through nozzles, Effect of friction, Nozzle efficiency, Critical pressure ratio and maximum discharge, calculation of throat and exit areas using Mollier Diagram.

UNIT - II

STEAM TURBINES: Types of steam turbines, Impulse turbines, velocity diagrams, pressure and velocity compounding, Reaction turbines, velocity diagrams, degree of reaction.

STEAM CONDENSERS: Jet and Surface condensers, Condenser vacuum and vacuum efficiency, Condenser efficiency, Thermodynamic analysis, Air pump.

UNIT – III

AIR COMPRESSORS: (Reciprocating) Working**,** Effect of clearance volume, compression ratio, volumetric efficiency, indicated power, Multi-stage compressors and effect of inter-cooling, optimum intermediate pressure in a two-stage compressor, (**Rotary**) Working principle of centrifugal and axial flow compressors, Comparison of reciprocating and rotary compressors, Applications.

GAS TURBINES:

Ideal Brayton cycle, Open and closed cycle gas turbines, Methods for improvement of thermal efficiency of gas turbine plant, applications of gas turbines, comparison of gas turbines with IC engines and steam turbines

UNIT - IV

REFRIGERATION: Applications of refrigeration**,** Methods of refrigeration, working of refrigerator and heat pump, refrigerating effect, COP, vapor compression refrigeration system, influence of various parameters on cycle performance, Refrigerant tables.

PSYCHROMETRY AND AIR CONDITIONING: Psychrometric properties, psychrometric relations, psychrometric chart, psychrometric processes, Comfort conditions, summer and winter air conditioning systems.

Text Books:

[1] Mahesh M. Rathore "Thermal Engineering" Fourth Edition, Tata- McGraw-Hill, 2010

[2] R.K. Rajput "Applied thermodynamics", second edition, Lakshmi Publications, 2014

Reference books:

[1] P.K. Nag "Basic and Applied Thermodynamics", second edition, Tata McGraw Hill, 2009

[2] C.P. Arora "Refrigeration and Air Conditioning" third edition, Tata McGraw Hill, 2009

[3] V Ganesan "Internal combustion engines" fourth edition, Tata McGraw Hill, 2017

E-resources and other digital material:

[1] Prof. T.Sundararajan, Prof. U.S.Premananda Shet and Prof. J.M.Mallikarjuna, IITMadras, Applied Thermodynamics, [English], Web
Available: http://nptel.ac.in/syllabus/112106133/

[2] Prof. Ravi Kumar, IIT Roorkee, Steam and Gas Power Systems, [English], Web
Available: http://nptel.ac.in/syllabus/112107216/

[3] Prof.M. Ramgopal, IIT Kharagpur, Refrigeration and Air Conditioning, [English], Web
Available: http://nptel.ac.in/syllabus/112105129/

[4] Dr.RaviKumar IITRoorkee, Refrigeration And Air-conditioning[English],Web
Available : https://onlinecourses.nptel.ac.in/noc18_me46/preview

Note: Use of Steam Tables, Refrigeration and Air-Conditioning Tables are permitted in Examinations.

20ME5302
DESIGN OF MACHINE ELEMENTS

Course Category: Programme Core **Credits**: 3
Course Type : Theory **Lecture/Tutorial/ Practice**: 3 /0/ 0
Prerequisites: **Continuous Evaluation**: 30
20ES1104B Engineering Mechanics - I **Semester end Evaluation**:70
20ES2104F Engineering Mechanics - II **Total Marks:**100
20ME3302 Mechanics of Materials
20ME3305 Kinematics of Machines

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Acquire knowledge about the design procedure of machine elements
CO2: Design power screws and apply fatigue failure criteria for machine components under various loading conditions
CO3:Design permanent fasteners such as the riveted, welded joints under various loadingconditions
CO4: Design temporary joints such as bolted joints and suspension systems such as helical springs.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1	M	H	H											M
CO2	M	H	H											M
CO3	M	H	H											M
CO4	M	H	H											M

(L-Low, M-Medium, H-High)

UNIT - I

Basics: Phases of design, Types of designs, standardization in design, preferred numbers and significance

Design for Static Strength: Simple Stresses - Combined stresses - Torsion and bending stresses - stress strain relation, various theories of failure - Factor of safety and its importance in design.

UNIT - II

Design for Fatigue Strength: Stress concentration - Theoretical stress concentration factor - Fatigue stress concentrations factor, Design for fluctuating stresses, Fatigue strength and endurance limit, Goodman diagram, Soderberg's line.

Power Screws: Types - Mechanics of power screws, efficiency, self-locking of screw and stresses in screw.

UNIT – III

Fasteners:

Riveted joints: Terminology, Design of Boiler Joints, Lozenge joint, Design of joints under eccentric loading.

Welded joints: Terminology, Advantages and Disadvantages of Welded Joints over Riveted Joints, Types of Welded Joints, Design of Eccentrically loaded welded joints - stresses induced on the jointbe of different nature (Case-1) and of the same nature (Case-2).

UNIT – IV

Bolted joints: Design of bolted joints under eccentric loading – Eccentric Load Acting Parallel to the Axis of Bolts, Eccentric Load Acting Perpendicular to the Axis of Bolts, and Eccentric Load Acting in the Plane Containing the Bolts.

Springs: Introduction, Materials, Types of springs, Helical springs under axial load, Fatigue loading.

Text Books:

[1] V B Bhandari, "Design of machine elements", Fourth Edition, Tata McGraw Hill Education Private Limited, 2017.

[2] P.C. Sharma & D.K. Agarwal, "A Text Book Of Machine Design" SK Kataria & Sons, 2013

Reference books:

[1] R.S Khurmi & J.K. Gupta, "A Text book of Machine Design" Fourteeenth Edition, S.Chand & Co Ltd,2015

[2] Robert L.Norton,"Machine Design- An Integrated Approach",Fifth Edition, Pearson Education, 2018.

[3] P. Kannaiah, "Machine Design", Second Edition, Scitech Publications Private Limited, 2011.

DATA BOOKS TO BE ALLOWED IN EXAMINATION:

[1] Mahadevan & Balaveera Reddy, "Design data book", - CBS Publishers

[2] V.B.Bhandari, "Design data book", Tata McGraw Hill book Co

[3] Design data book, P.S.G. College of Technology, Coimbatore

E-resources and other digital material:

[1] http://nptel.ac.in/courses/112/105/112105124/

[2] http://nptel.ac.in/courses/112/105/112105125/

[3] http://nptel.ac.in/courses/112/106/112106137/

20ME5303
MACHINE TOOLS AND METAL CUTTING

Course Category: Programme Core **Credits**: 2
Course Type : Theory **Lecture/Tutorial/ Practice**: 2 /0/ 0
Prerequisites: **Continuous Evaluation**: 30
20 ME 3304 Manufacturing Processes **Semester end Evaluation**:70
20 ME 3302 Mechanics of Materials **Total Marks:**100

Course Outcomes:
Upon successful Completion of the course, the student will be able to:

CO1: Recognize the basic principles, constructional features of Lathe and its mechanisms andoperations.
CO2: Exemplify the working principle, operations of drilling machines and Milling machines
CO3: Distinguish various machining processes such as Shaping, Planing, grinding and broaching.
CO4: Recognize the fundamental concepts of Metal Cutting, cutting tool materials, and tool life.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1	H													L
CO2	H													L
CO3	H													L
CO4	M													L

(L-Low, M-Medium, H-High)

UNIT - I
KINEMATIC CONFIGURATION OF MACHINE TOOLS: Introduction, Classification of Machine Tools, Basic elements of machine tools, Machining Parameters: Cutting speed, feed and depth of cut.

LATHE: Constructional details, specifications, classification of lathes.

LATHE MECHANISMS: Spindle speed Mechanisms in Belt driven and All Geared Head stock, Apron and Half-nut mechanisms, Lathe accessories, Lathe Operations.

UNIT – II
DRILLING MACHINES: Types and specifications, Spindle feed mechanism, drilling operations, drilling time.

MILLING MACHINES: Working Principle, Types of milling machines, Up and Down Milling, Description and working of Universal Milling machine, Size and Specification, Milling operations, Milling cutters, Indexing methods and Indexing Head, related problems.

UNIT – III

SHAPING AND PLANING: Constructional details, types of Shapers and Planers, specifications, operations, quick return mechanism and automatic feed mechanisms.

GRINDING: General Principles, Wheel materials, Selection and specifications, Truing and Dressing of grinding wheels, types of grinding, types of grinding machines. Honing, Lapping and Burnishing operations.

BROACHING: Introduction to Broaching, broaches, broaching methods and Machines.

UNIT – IV

THEORY OF METAL CUTTING: Introduction, Nomenclature of single point cutting tool, Basicsof orthogonal and oblique cutting, Mechanics of chip formation, Types of chips. Determination of shear angle and chip thickness ratio, stress and strain in the chip, velocity relations, Merchants theory of orthogonal cutting forces, related simple problems. Heat Generation and cutting tool temperature and its measurement, cutting fluids - types and required characteristics. Cutting tool materials: Requirements of Tool materials and types, Tool wear, Tool life and Tool life criteria.

Text Books:

[1] Workshop Technology - Vol.2 by HazraChowdary, 11th Edition,2002.
[2] Manufacturing Technology - Vol.2 by P. N. Rao, McGraw Hill Education (India) Pvt. Ltd., 3rd Edition, 2013.
[3] Manufacturing Technology by R. K. Rajput, Laxmi Publications (P) Ltd., 1st Edition, 2007

Reference books:

[1] Production Engineering by P.C. Sharma, S.Chand & Co. 10th Edition,2008
[2] Manufacturing Science by Ghosh &Mallick, 2nd Edition, John Wiley & Sons, New York, 1986.

E-resources and other digital material:

[1] https://openoregon.pressbooks.pub/manufacturingprocesses45/
[2] www.britannica.com/EBchecked/topic/463000/planer
[3] www.americanmachinist.com/
[4] http://www.machinetools.net.tw/

20ME5404 A
IC ENGINES & GAS TURBINES

Course Category: Programme Elective
Course Type: Theory
Prerequisites:
20ME3303 Basic Thermodynamics
20ME5301 Applied Thermodynamics

Credits: 3
Lecture/Tutorial/Practice: 3 /0/ 0
Continuous Evaluation: 30
Semester end Evaluation:70
Total Marks:100

Course Outcomes:
Upon successful completion of the course, the student will be able to:

CO1: *Interpret* the working of IC engines and *analyze* their performance
CO2 *Understand* the importance of Fuel supply, combustion & alternate fuels in I.C. Engines.
CO3: *Analyze* Gas Turbine cycles and their performance
CO4: *Interpret* the engine emissions and *analyze* Jet and rocket propulsion

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSOII
CO1	H	M											M	
CO2	M	M											M	
CO3	H	M											M	
CO4	H	M											M	

(L-Low, M-Medium, H-High)

UNIT – I
I.C.Engines: Engine nomenclature, Review and classification of I.C. Engines, working principlesof S.I. and C.I. Engines - valve timing diagrams and port timing diagrams, principle and working of Wankel engine

Testing of I.C.Engines: Indicator diagram, evaluation of Indicated Power, Brake power,Fuel consumption, SFC, Mechanical & thermal efficiencies, mean effective pressure, air-fuel ratio, Heat balance, Engine performance curves

Developments in IC Engines: MPFI, GDI, CRDI, VVT, HCCI & Hybrid Technologies

UNIT – II
Fuel supply systems: S.I. Engines- Air-fuel mixture requirements, principle of Carburetion, Simple carburetor, improvements in simple carburetor. I.C Engines- Air fuel requirements, Fuel supply and injection systems, Bosch fuel pump and injector.

Combustion in IC Engines: S.I. Engines- Normal combustion, abnormal combustion, C.I. Engines- Ignition delay, knock in C.I.Engines; Knock rating of fuels- Octane number and Cetane number, super charging, Turbo charging

Alternate fuels: Liquid fuels – Alcohols for SI and CI engine Biofuels, Gaseous fuels – Hydrogen, Natural gas, Biogas, CNG and LPG

UNIT – III

Gas Turbines: Classification of Rotary Machines, Thermodynamic Analysis, Closed andopen Brayton cycle gas turbines, comparison with Reciprocating Engines.

Analysis of gas turbine cycles- Assumptions, gas turbine cycles with intercooling, reheat and regeneration, Stagnation properties, compressor and Turbine Efficiency, pressure losses, Heat Exchanger Effectiveness, , polytropic Efficiency, performanceof Actual Cycle.

UNIT – IV

Engine emissions and control: Exhaust emissions- HC, CO, Nox, Particulate and other emissions, Emission control methods- Thermal converter, catalytic converter, particulate traps,EGR, Euro and Bharat Norms.

Jet and Rocket Propulsion: Basic principles of jet propulsion, specific thrust, propulsive efficiency and overall thermal efficiency of a jet engine, concepts of turboshaft, turboprop, turbofan, Turbojet, principles of rocket propulsion, types of rocket propulsion-Solid and liquid rocket engines.

Text Books:

[1] V.Ganesan "I.C. Engines", 4th Edition, 2017, T.M.H Publications

[2] 2. Gupta .H.N, "Fundamentals of Internal Combustion Engines" 2nd edition 2013, Prentice-Hall Of India

[3] 3 V.Ganesan, Gas Turbines, 3rd Edition,2017, T.M.H Publications.

Reference books:

[4] Mahesh M Rathore,Thermal Engineering, Tata Mcgraw Hill publications

[5] R.K.Rajput, I. C. Engines

[6] M.L. Mathur & R.P. Sharma, "A Course in I.C. Engines", 8th edition 1990, Dhanpat Rai & Sons

[7] J.B Heywood, Internal Combustion Engine Fundamentals, McGrawHill

[8] V.M. Domakundwar, "A Course in Internal Combustion Engines" 2nd edition 2010, Dhanapat Rai Publications

E-resources and other digital material:

1. http://www.howstuffworks.com/engine.html
2. http://www.animatedengines.com/
3. www.vssut.ac.in/lecture_notes/lecture1429900545.pdf
4. http://freevideolectures.com/Course/88/Environmental-Air-Pollution/11
5. ftp://152.66.39.22/pub/bsc/Internal_Combsution Engines-Temp.pdf
6. https://www.ge.com › gas-power › resources › education

20ME5404 B
REFRIGERATION AND AIR CONDITIONING

Course Category: Programme Elective **Credits**: 3
Course Type : Theory **Lecture/Tutorial/ Practice**: 3 /0/ 0
Prerequisites: 20ME3303 Basic Thermodynamics **Continuous Evaluation**: 30
Semester end Evaluation:70
Total Marks:100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: ***Analyze*** air refrigeration system and systems used in aircrafts.

CO2: ***Interpret*** simple VCR cycle and *compare* various components of VCR systems.

CO3: ***Select*** the most appropriate refrigerant for a given cooling application and ***interpret*** theimpact of refrigerants on the environment

CO4: ***Illustrate*** the vapor absorption and other non-conventional refrigeration systems and their application as alternatives to VCR systems.

CO5: ***Compute*** psychrometric properties of air and ***analyze*** A/C processes & systems andHeat pump circuits to design real world heating & cooling needs.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO 1	M	M	H										M	
CO 2	M	M	H										M	
CO 3	M		H				H						M	
CO 4	M		M				M						M	
CO 5	H	M	H				L						M	

(L-Low, M-Medium, H-High)

UNIT I:

Introduction to refrigeration: Applications, methods of refrigeration, unit of refrigeration, C.O.P.

Refrigerants- classification, nomenclature, desirable properties, commonly used refrigerants and alternative refrigerants.

Air refrigeration: Bell Coleman cycle, Open and Dense air systems, Actual refrigeration cycle, advantages of air refrigeration, refrigeration needs of aircrafts, types of aircraft refrigeration systems,problems.

UNIT – II:

Vapor compression refrigeration: simple vapor compression refrigeration cycle, T-S, P-h diagrams, Effect of super heating, sub cooling, evaporative and condenser pressures, pressure losses, problems. **VCR System components:** Compressors- types, comparison, Condensers - classification,working,Evaporators – Flooded and dry expansion types, Expansion devices –AEV, TEV and capillary tube.

UNIT – III:

Vapor absorption system: COP of absorption system, max COP, working of NH_3 - Water system,H_2O –Li Br system, three fluid absorption systems, comparison between VCR and VAR systems.

Steam jet refrigeration system: Principle of working, applications merits and merits.

Non-conventional refrigeration methods: Principle and operation of thermoelectric refrigeration,Vortex tube and adiabatic demagnetization.

UNIT – IV:

Air conditioning: Psychrometry- Psychrometric properties and processes, Psychrometric chart, Summer, winter and year round A/C systems, human comfort and effective temperature.

Cooling Loads: Sensible and latent heat loads, RSHF, GSHF, ESHF & ADP, air conditioning load Calculations, Types of heating, heat pump, different heat pump circuits, application.

Text books:

[1] A course in refrigeration and air conditioning - S. C. Arora, Domkundwar, 2014.

[2] Refrigeration and air conditioning - C. P. Arora. Tata McGraw-Hill, 7th Print, 2006

Reference books:

[1] Principles of Refrigeration - Dossat., 4th Reprint 1997,Pearson Education Ltd. [2] Refrigeration and air conditioning - Stoecker and Jones 1983, McGraw Hill

Data Books:

[1] Refrigeration & Air conditioning Data book by Domkundwar&Domkundwar ,DhanapatRai& Co.

[2] Refrigerant &Psychrometric Tables &charts., SS Banwait and SC Laroiya, Birla pub. pvt ltd.

E-resources and other digital material:

[1] http://www.refrigerationbasics.com/index.htm

[2] http://www.howstuffworks.com/ac.htm

[3] http://www.ashrae.org

[4] http://www.taftan.com/thermodynamics/AIRCOND.HTM

[5] http://www.wisegeek.com/how-does-air-conditioning-work.htm

20ME 5404 C
JET & ROCKET PROPULSION

Course Category: Programme elective **Credits**: 3
Course Type : Theory **Lecture/Tutorial/ Practice**: 3 /0/ 0
Prerequisites: **Continuous Evaluation: 30**
20ME3303 Basic Thermodynamics **Semester end Evaluation**: 70
20ME5301 Applied Thermodynamics **Total Marks:** 100
Course Outcomes:

Upon successful Completion of the course, the student will be able to:
CO1: Analyse the methods to improve efficiency of gas turbine and evaluate the performance of axial flow compressor.
CO2: Evaluate the performance of axial flow turbines and discuss their applications
CO3: Analyse the performance of jet propulsion systems.
CO4: Explain the working of Rocket Propulsion Systems.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1		L	M										L	
CO2		L	M										L	
CO3		L	M	L									L	
CO4				L									L	

(L-Low, M-Medium, H-High)

UNIT I:

Introduction: Classification, working principle of Gas turbines, open and closed cycles, methods to improve performance of the ideal cycle-Regeneration, Reheating and intercooling.

AXIAL FLOW COMPRESSORS: Principle of operation, stage velocity triangles, work input to the compressor, work done factor, Compressor stage efficiency, Degree of Reaction, Surging, choking and stalling.

UNIT II:

AXIAL FLOW TURBINES: Working principle, Velocity triangles of single stage turbine, Work output, Blade and stage efficiencies, Degree of Reaction - fifty per cent reaction stage.

APPLICATIONS OF GAS TURBINES: Typical applications of gas turbines - electric power generation applications - marine application, locomotive applications, automotive applications -

aircraft applications - process applications, additional features of gas turbine engines - trends in future development.

UNIT III:

JET PROPULSION: Introduction, Air breathing jet engines, classification - Ram jet, Pulse jet, Turbo jet, Turbo prop, Thrust and thrust equation, Efficiencies - Ram, thermal, transmission, overall.

UNIT – IV

ROCKET PROPULSION: Principle, classification – Analysis of an ideal chemical rocket- Chemical rocket, solid propellant, liquid propellant, advantages, nuclear propulsion, electro dynamic propulsion, photon propulsion.

Text Book:

[1] Gas Turbines - Ganesan V., TMH.

[2] Gas turbines and propulsive systems - Khajuria P.R., Dubey S.P., Dhanpat Rai Pub.

[3] Gas turbines and Jet & Rocket propulsion - Mathur M.L., Sharma R.P. Standard Pub.

Reference Books:

[1] Gas Turbine Theory - Cohen H., Rogers G. and Saravanamuthu H., John Wiley.

[2] Turbines, Compressors and Fans - Yahya S.H, Tata McGraw-Hill.

[3] Aero-thermodynamics of gas turbine and rocket propulsion - Gordon Oates, AIAA Education series

E-resources and other digital material:

[1] http://nptel.ac.in/courses/101101002/

[2] http://nptel.ac.in/courses/112104117/13

20ME5205A
ROBOTICS

Course Category: Open Elective/Job Oriented Elective **Credits**: 3
Course Type : Theory **Lecture/Tutorial/ Practice**: 3/0/ 0
Prerequisites: **Continuous Evaluation**: 30
Engineering Mechanics (20ES2104-I) **Semester end Evaluation**: 70
Kinematics of Machines (20ME3305) **Total Marks:** 100
Basic Electronics (20ES4102)

Course Outcomes:
Upon successful completion of the course, the student will be able to:
CO1: Classify Robotic Manipulator and Identify its performance specifications
CO2: Analyze Robot End-Effector interfacing issues
CO3: Select sensors relevant to a Robotic Application
CO4: Apply Transformations with reference to Robot Kinematics & Programming issues

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1	M	L												M
CO2	M	L												M
CO3	M	L												M
CO4	M	M												M

(L-Low, M-Medium, H-High)

UNIT – I
Introduction to Robotics: Definition of a Robotic System, Major components of a Robotic System, Industrial Manipulator, Classification of Robotic Manipulators, Classification by coordinate system and by control method, Performance Specification of Robotic Manipulators, Overview of Robotic Applications.

UNIT – II
Robotic End-Effectors: Introduction, types of end effectors, grippers, classification of grippers, Gripper mechanisms, other types of grippers-Vacuum cups, Magnetic grippers, adhesive grippers and miscellaneous types. Tool as end effectors, End-effector Interfacing issues, considerations in gripper selection and design. Recent developments with regard to robotic end-effectors.

UNIT – III
Sensors in Robotic Systems: Importance of Sensors, External and Internal State sensors, Active and Passive Sensors. Sensor types: Position and Velocity Sensors, Inertial Measurement Unit, Proximity and Range sensors, Touch and/ or Tactile sensors, Slip sensors, Force and Torque Sensors**,** Remote Centered Compliance device, Vision Sensors; Analysis of Automated Guided Vehicle, Robotic Manipulator, Humanoid Robot with regard to relevant sensors.

UNIT – IV

Transformations: Design and Control aspects in Robotic manipulators, Importance of Forward and Inverse Kinematics, Translational & Rotational Transformations, Homogenous coordinate system representation and its importance, Simple problems on Transformations.

Robot programming: Lead through Programming, Textual Programming Methods, Programming language structure, wait signal & delay commands, branching in Robot programme.

Text Books:

[1] Robotic Engineering by Richard D. Klafter, Prentice Hall, Tata Mc Graw-Hill, 1995. 3rd Edition.
[2] Industrial Robotics by Mikell P.Groover, TMH

Reference books:

[1] Introduction to Robotics – John J. Craig, Addison Wesley,3rd Edition
[2] Robotics – K. S. Fu, Gonzalez & Lee, Tata Mc Graw-Hill, 1995. 3rd Edition.
[3] Robotics for Engineers by Yoram Koren. Tata Mc Graw-Hill, 1995. 3rd Edition.
[4] Robot Dynamics and Control by M Vidyasagar and Mark W Spong, Wiley Publications.

E-resources and other digital material:

[1] https://ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics-fall-2005/
[2] https://see.stanford.edu/Course/CS223A

20ME5205 B

COMPUTER GRAPHICS AND GEOMETRICALMODELLING

Course Category: Open Elective/Job oriented elective **Credits**: 3
Course Type: Theory **Lecture/Tutorial/ Practice**: 3/0/0
Prerequisites: **Continuous Evaluation**: 30
20BS1105 Engineering Graphics **Semester end Evaluation**: 70
20BS1101 Matrices and Differential Calculus **Total Marks:** 100

Course Outcomes:
Upon successful completion of the course, the student will be able to:
CO1: Recognize the importance of graphic primitives
CO2: Analyse the polygon interfacing and clipping algorithms
CO3: Understand parametric and Non-parametric representations of graphic entities
CO4: Apply the Graphic transformations and Windowing techniques

Contribution of Course Outcomes towards the achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1	M				M									M
CO2	H				M									M
CO3	H				H									M
CO4	H				H									M

(L-Low, M-Medium, H-High)

UNIT – I:
Computer Graphics: Introduction, History, Classification of Computer Graphics, Components of Computer Graphics.
Graphic Primitives: Introduction, Display devices, Primitive operations, The Display-File Interpreter, Normalized Device Coordinates, Display-File structures.
Point Plotting Techniques: Coordinate system, Incremental methods
Line Drawing Algorithms: DDA algorithm, Bresenham's line drawing algorithm, Mid-point Circle algorithm.

UNIT – II:
Line Drawing Displays: Introduction, CRT, LCD display systems, Raster displays, Plasma Display Panel, Laser Scan Display.
Polygons: Introduction to Polygons, Polygon representation, Polygon Interfacing Algorithms, Filling Polygons.
Clipping: Introduction to Clipping, Cohen-Sutherland Algorithm and Clipping of Polygons.

UNIT – III:
Introduction to CAD: Fundamentals of CAD, Design process, Applications of Computer for design, Benefits of CAD, Design Workstation, Graphic terminal, Input output devices in CAD.
Wire frame Modeling: 2D wire frame modeling, 3D Wire frame modeling, Wire frame models, Entities and their definitions. Parametric and non-parametric representations of curves.
Surface Modeling: Surface modeling and entities, Surface Representation, Parametric representation of surfaces like Plane, Ruled surface, Surface of revolution, Parametric representation of synthetic surfaces like Blending surface.

Computational Tools for AM Design Analysis: Considerations for Analysis of AM Parts, Material Data, Surface Finish, Geometry, Simplifying Geometry, Mesh-Based Versus Parametric Models, Build Process Simulation: Model Slicing, Contour Data Organization, Layer-by-Layer Simulation, Hatching Strategies, Scan Pattern Simulation and Tool Path Generation.

UNIT – IV:

Solid Modeling: Solid models, Solid entities, Boolean Operations, Solid representation, Sweep representation, Constructive Solid Geometry (CSG), Boundary representation (B-rep).

Transformations: Introduction, Matrices, Scaling Transformations, Sin and Cos, Rotation, Homogeneous Coordinates and Translation, Coordinate Transformations, Rotation about an arbitrary point, Inverse Transformations

Windowing: Windowing, Viewport and Viewing Transformation.

Text Books:

[1] Computer Graphics by Dr. Rajiv Chopra, S. Chand Publication, Third Edition 2014.
[2] Computer graphics by Steven Harrington, McGraw-Hill International Editions, Second Edition.
[3] CAD/CAM by Mikel P. Groover and Emory W.Zimmers, Prentice Hall of India, Delhi, 3rd Edition -2007.
[4] CAD/CAM by Ibrahim Zied, 5th Re print -2002. TMH.
[5] CAD/CAM Theory and Practice by Ibrahim Zied, R.Sivasubramanian, McGraw Hill, Second Edition, 2015.
[6] A Practical Guide to Design for Additive Manufacturing, Diegel, Olaf, Axel Nordin, and Damien Motte, Springer, 2020.

Reference books:

[1] Computer Aided Design and Manufacture by C.B.Besant, and C.W.K.Lui, Affiliated East –West Press Pvt Ltd, New Delhi. 3rd Edition -2007.
[2] Procedural elements for Computer Graphics by Rogers.
[3] Principles of Interactive Graphics by Newman and Sproull.

E-resources and other digital material:

[1] http://en.wikipedia.org
[2] http://www.caddprimer.com/
[3] http://www.compinfo-center.com/cad/cad.htm
[4] http://www.srikumar.com/cad/cad.html
[5] http://www.tenlinks.com/CAD/reference/directories.htm
[6] https://doi.org/10.1007/978-981-13-8281-9_4

20ME5351
FUELS AND I.C.ENGINES LABORATORY

Course Category: Programme Core **Credits:** 1.5
Course Type: Laboratory **Lecture-Tutorial-Practice:** 0-0-3
Continuous Evaluation: 30 **Semester end Evaluation:** 70
Hours: 3/week **Total Marks:** 100
Prerequisites: Knowledge on working of Fuels & I.C.Engines.

Course Outcomes:

Upon successful completion of the course the students will be able to

CO1 Measure the thermal properties of different fuels & lubricants
CO2 Determine the efficiency of Compressor and Blower
CO3 Evaluate the operating characteristics of I.C.engines
CO4 Draw the valve and port timing diagrams of two and four stroke Engines.
CO5 Calibrate a pressure gauge for accuracy

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSOII
CO1	M			H		H							M	
CO2	M			H									M	
CO3	M			H		H							M	
CO4	M			H									L	
CO5	M			H									L	

(L-Low, M-Medium, H-High)

Course Contents: Any Ten of the following:

Fuels Laboratory:

1. To determine the viscosity of the given sample of oil at various temperatures in Redwood standard seconds using Redwood Viscometer.
2. To test the given pressure gauge using Dead weight pressure gauge tester.
3. To draw the port/valve time diagram of petrol/diesel engine.
4. To determine the calorific value of the given solid fuel by Bomb Calorimeter
5. To determine the Flash and Fire Points of the given oil by Abel's Apparatus.
6. To determine the calorific value of the given gaseous fuel by Junker's Gas Calorimeter
7. To study assembling and disassembling of Two stroke, single cylinder petrol engine

I.C.Engines Laboratory:

1. To conduct a performance test on a four stroke, single cylinder Diesel engine With Band brake Dynamometer.
2. To conduct a performance test on twin cylinder diesel engine with electrical Dynamometer.
3. To conduct a test on Air compressor to determine the volumetric efficiency and isothermal efficiency at various delivery pressures.
4. To measure the discharge of air through the blower test rig.
5. To conduct a performance test on a four stroke, single cylinder Petrol/LPG engine with Eddy current dynamometer..
6. To Prepare Heat Balance sheet on single cylinder Diesel/petrol engine.
7. To conduct a performance test on a four stroke, single cylinder Diesel engine with Band brake Dynamometer using Bio-Diesel.

Reference: Internal Combustion Engines - V. Ganesan, TMH Pub.

20ME5352
MACHINE TOOLS LABORATORY

Course Category : Programme Core **Credits:** 1.5
Course Type : Practical **Lecture/Tutorial/Practice:** 0/0/3
Prerequisites: 20ES1153 Workshop practice Lab **Continuous Evaluation:** 30
20ME5303 Machine tools and Metal cutting **Semester End Evaluation:** 70
Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:
CO1: Illustrate Lathe machine constructional details and perform various Lathe operations.
CO2: Exhibit the ability in developing sequence of machining operations using drilling machine.
CO3: Demonstrate milling machine constructional details and perform different Milling operations.
CO4: Develop the models independently by using Shaping, Planning and Slotting machines.
CO5: Explain the Surface and centerless Grinding machine constructional details and perform various grinding operations.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO 1			H	H										H
CO 2			H	H										H
CO 3			H	H										H
CO 4			H	H										H

(L-Low, M-Medium, H-High)

Course content

1. Lathe:
(a) Step Turning, Taper Turning, Knurling, Threading, Drilling and Boring.
(b) Measurement of cutting forces using dynamometer during turning operation.

2. Drilling:
Drilling, Reaming, counter boring and counter sinking on drilling machine.

3. Milling:
(a) Manufacturing of Key-way, concave & convex, dovetail cutting, T-slot cutting
(b) Gear manufacturing using indexing mechanism in milling machine.

4. Shaping:
Making models by involving production of flat surface, External keyway cutting, Stepcutting and internal keyway cutting on shaping machine.

5. Planing and Slotting:
(a) Plain surface finishing performed by planning machine
(b) Making of round to square shape, internal keyways and external keyways by Slotting Machine.

6. Tool and cutter grinding and centerless grinding Machine

(a) Grinding of Single Point Cutting Tools and Multi point cutting tool cutters and drill bit grinding by Tool and Cutter grinding machine.

(b) Finishing of cylindrical jobs by using centerless grinding Machine

Text Books:

[1] S.K.HajraChowdary, A.K. HajraChowdary, NirjharRoy, "Elements of Workshop Technology, Vol.II".Media Promoters and Publishers Pvt.Ltd, Mumbai,Scitech Publications, Chennai, 2013

20ME5353
DESIGN AND METROLOGY LAB

Course Category: Programme Co
Credits: 1.5
Course Type: Laboratory
Lecture/Tutorial/Practice:0/0/3
Prerequisites:
Continuous Evaluation: 30
Machine Dynamics- 20ME4303
Semester end Evaluation: 70
Mechanical Vibrations- 20ME6404B
Total Marks: 100

Course Outcomes:
Upon successful completion of the course, the student will be able to:
CO1: Evaluate the time period of oscillations of simple, compound pendulum, Single and doublerotor shaft systems.
CO2: Determine the whirling speed of shafts under different boundary conditions and understandthe gyroscopic effect of moving bodies
CO3: Measure the internal taper angle, external taper angle, tool signature, elements of agiven thread by using metrology instruments
CO4: Demonstrate the working and applications of surf tester, comparator, FFT analyzerand gauges

Contribution of Course Outcomes towards the achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO 1	L			M										M
CO 2	L			M										M
CO 3	L			M										M
CO 4	L			M										M

(L-Low, M-Medium, H-High)

Course Content Design

Laboratory:

1. Vibration measurements: Simple pendulum.
2. Vibration measurements: compound pendulum.
3. Vibration measurements: Single and double rotor shaft system
4. Determine the whirling speed of shafts.
5. Understand the gyroscopic effect of moving bodies using Motorized Gyroscope.
6. User defined design based experiment.

Metrology laboratory:

1. Measuring external taper angle of a given work piece using sine bar.
2. Measuring external taper angle of a given work piece using roller and slip gauges.
3. Measuring internal taper angle of a given work piece using Vernier depth gauge.

4. Measuring screw thread effective diameter by using three wire methods.
5. Measuring different elements of a thread using profile projector.
6. Measuring angular dimensions of a tool using tool -maker's microscope.
7. Measurements of surface finish using surf tester

Model Demonstrations:

1. Vibration measurements by using FFT Analyzer.
2. Co-ordinate Measuring Machine
3. Demonstration of various gauges

E-resources and other digital material

1. www.iitg.ernet.in/scifac/qip/public.../r.../chapter_5_gyroscope.pdf
2. www.nptel.ac.in/courses/112101096/download/lecture-25.pdf
3. https://en.wikipedia.org/wiki/Critical_speed
4. https://www.youtube.com/watch?v=HpIEeBtJupY

20TP5106
PERSONALITY DEVELOPMENT

Course Category: Institutional Core
Course Type : Learning by Doing
Prerequisites:

Credits: 1
Lecture/Tutorial/ Practice: 0 /0/ 2
Continuous Evaluation: 100
Semester end Evaluation: 00
Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Understand the corporate etiquette .
CO2: Make presentations effectively with appropriate body language .
CO3: Be composed with positive attitude
CO4: Understand the core competencies to succeed in professional and personal life

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1												M		
CO2												M		
CO3												M		
CO4												M		

(L – Low, M- Medium, H – High)

UNIT – I

1. Self-Introduction
2. Shaping Young Minds – A Talk by Azim Premji (Listening Activity)
3. Self – Analysis, Developing Positive Attitude
4. Perception – Importance of analytical thinking

UNIT – II

1. Communication Skills – Need and Methods
2. Body-Language-I; How to interpret and understand other's body language
3. Body Language – II; How to improve one's own Body Language
4. Anger Management

UNIT – III

1. Stress Management
2. Time Management – Methods of using time effectively
3. Social , Business & Dining Etiquette
4. Telephone and Email Etiquette

UNIT-IV

1. Standard Operation Methods - Note Making & Note Taking
2. Minutes Preparation
3. Email Writing
4. Email – Practice Session
5. Letter Writing – Formal & Informal

UNIT – V

1. Team Building
2. Leadership Qualities
3. Six Thinking Hats

UNIT – VI

1. Vocabulary
2. Correction of Sentences
3. Sentence Completion – Course of Action
4. Sentences Assumptions

UNIT – VII

1. Sentence Arguments
2. Reading Comprehension-Practice work
3. Group Discussion
4. Group Discussion – Practice Session

UNIT-VIII

1. Resume Preparation
2. Interview Skills
3. Mock Interviews

Methodology: Audio—Visuals / Hand Outs (Compiled/Created by Training Division, T&P Cell, VR Siddhartha Engineering College), Board & Chalk and Interactive Sessions.

20ME5354
EPICS / INTERNSHIP

Course Category : Institutional core
Course Type : Practical
Prerequisites:

Credits: 1.5
Lecture/Tutorial/Practice: 0/0/3
Continuous Evaluation: 30
Semester End Evaluation: 70
Total Marks: 100

CO1: Identify the problem, define objectives and scope of the project work

CO2: Carryout Team work

CO3: Prepare and present a comprehensive report of the project work

CO4: Apply the principles of Thermal Engineering to solve problems

CO5: Solve Engineering problems using the concept of design and manufacturing

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSOII
CO1												H		
CO2									H					
CO3								M		H				
CO4	M	H		M	M			M					H	
CO5	M	H		M	M			M						H

20ME5607
MECHATRONICS LAB

Course Category: Skill Oriented Course -2 **Credits**: 2

Course Type : Laboratory **Lecture/Tutorial/ Practice**: 1/0/2

Prerequisites: Fundamentals of Electronics Components **Continuous Evaluation:** 30

Semester end Evaluation: 70

Total Marks: 100

Course Outcomes:

Upon successful completion of the course, a student will be able to:
CO1: Identify Sensors and actuators used in mechatronic systems
CO2: Use Microcontroller to accomplish measurement and control tasks
CO3: Generate mathematical models of basic physical systems and Simulate their performance
CO4: Analyze the influence of closed loop controllers viz. P, PD, PI, PID etc.
CO5: Simulate the operation of hydraulic/ pneumatic systems using PLC based trainer kits

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSOII
CO1			M	M										M
CO2			M	M										M
CO3				M	M									M
CO4				M	M									M
CO5				M	M									M

(L-Low, M-Medium, H-High)

Lab Exercises:

1. Build simple electronic circuits comprising of Resistors, Capacitors, Transistors, MOSFETs, ICs and Breadboards for creating an application.
2. Study of Arduino Microcontroller board and its usage to measure angular rotation, lighting LEDs etc.
3. Measure temperature using a thermocouple and study data acquisition.
4. Measure stress and strain produced in a beam, using strain gauge-based sensors.
5. Control of a DC motor using Arduino Microcontroller board.
6. Create a mass-spring-damper model and simulate its behavior, using MATLAB/SIMULINK.

7. Simulate the influence of closed loop controllers viz. P, PD, PI, PID etc.
8. Study basic elements used in a hydraulic/ pneumatic system using trainer kits.
9. Implementation of logic gates viz. OR, AND, NOR, NAND etc. through PLCs.
10. Control of a single acting cylinder using a Solenoid valve through PLC.
11. Simulate the operation and control of a motor using MATLAB/ SIMULINK.
12. Study operation of an Automatic Conveyor Belt.

Text Books:

[1] Mechatronics Electronic control systems in Mechanical and Electrical Engineering by W. Bolton, PEARSON, 4th Edition, 2011.
[2] Introduction to Mechatronics – David and Alcaitore Michael B.Histand TMH, 4th Edition, 2006.

Reference books:

[1] E.O. Deobelin, "Measurement Systems –Application and Design", Tata McGraw Hill, 2004.
[2] H S Kalsi, "Electronic Instrumentation", 2nd Edition, Tata McGraw Hill
[3] A Barua, "Fundamentals of Industrial Instrumentation", Wiley India, 2011.

E-resources and other digital material:Web Resources:

[1] https://www.mechatronics.colostate.edu/
[2] https://eil-iitg.vlabs.ac.in/
[3] https://www.researchgate.net/publication/310239627_Mechatronics_Lab_Manual_ME_6712
[4] www.NI.com

Video references:

[1] https://www.youtube.com/watch?v=o4_NeqlJgOs
[2] https://www.youtube.com/watch?v=0cpSi8C95DY
[3] https://www.youtube.com/watch?v=Hx33qw-z_cQ
[4] https://www.youtube.com/watch?v=ZApY8wwWPpg
[5] https://www.youtube.com/watch?v=19aGHGMOx1w

20MC5108 B
INNOVATION, IPR AND ENTREPRENEURSHIP

Course Category: Mandatory Course
Course Type: Theory
Prerequisites: -

Credits: 0
Lecture/Tutorial/ Practice: 2/0/0
Continuous Evaluation: 100
Semester end Evaluation: 0
Total Marks: 100

Course Outcomes:
Upon successful completion of the course, the student will be able to:
CO1: Understanding the concept of innovation and its importance in organizations.
CO2: Apply innovation management strategy in new product development.
CO3: Understanding the Intellectual Property Rights and the key legal aspects
CO4: Analyze the concept of entrepreneurship and skills

Contribution of Course Outcomes towards the achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1		L						M	M		M			
CO2		M						L	M		M			
CO3		M						M	H		H			
CO4		L						H	M		M			

(L-Low, M-Medium, H-High)

UNIT – I:
INNOVATION MANAGEMENT: INTRODUCTION
Definition of Innovation - Need for Innovation - Types of Innovation (Product, Process and Organization) - Sources of Innovation - Technology Adoption - Barriers to Innovation

UNIT – II:
INNOVATION: NEW PRODUCT DEVELOPMENT
Meaning and Classification of New Product - Role of Innovation in New Product Development - Key Factors in New Product Development Strategy - Organizational Growth through New Product Development – Managing Innovations

UNIT – III:
INTELLECTUAL PROPERTY RIGHTS (IPRs)
Definition of IPRs - Need for IPRs - Kinds of Intellectual Property Rights: Patents, Copyrights, Trade Marks, Trade Secret, Design, Geographical Indications - Legal Aspects of IPRs - IPRs in India.

UNIT – IV:
ENTREPRENEURSHIP

Concept and Nature of Entrepreneurship - Need for Entrepreneurship - Types of Entrepreneurship - Entrepreneurial Skills - Emerging Trends in Entrepreneurship - Environment for Entrepreneurship

Text Books:
[1] Paul Trott, Innovation Management and New Product Development, PearsonEducation Limited, UK, 2017.
[2] Nithyananda, K V., Intellectual Property Rights: Protection and Management,Cengage Learning India Private Limited, 2019.

[3] Dr.S S Khanka, Entrepreneurial Development, S Chand, New Delhi, 2020.

Reference books:

[1] Managing innovation: Integrating Technological, Market and OrganizationalChange, Joe Tidd, John Besant, 2018.

[2] Neeraj, P., & Khusdeep, D, Intellectual Property Rights. PHI learning PrivateLimited, India, 2019.

[3] Vasant Desai, The Dynamics of Entrepreneurial Development and Management,Himalaya Publishing House, India, 2022.

E-resources and other digital material:

[1] https://edisciplinas.usp.br/pluginfile.php/5553082/mod_folder/content/0/Trott%20-%202017%20-%20%20roz%20Innovation-Management-and-New-Product- Development.pdf?forcedownload=1

SIXTH SEMESTER

20ME6301
DESIGN OF TRANSMISSION SYSTEMS

Course Category: Programme Core
Course Type : Theory
Prerequisites:
20ES1104C Engineering Mechanics – I
20ES2104F Engineering Mechanics – I
20ME 3305 Kinematics of Machines
20 ME 3302 Mechanics of Materials
20 ME 5302 Design of Machine Elements

Credits: 3
Lecture/Tutorial/ Practice: 3 /0/ 0
Continus Evaluation: 30
Semester end Evaluation:70
Total Marks:100

Course Outcomes:
Upon successful Completion of the course, the student will be able to:
CO1: Design shafts, keys and couplings under different loading conditions.
CO2: Design journal and roller bearings.
CO3: Design different types of clutches and brakes for variousapplications.
CO4: Determine the key design parameters for spur gears, helical gears, piston and connectingrod.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSOII
CO1	M	H	H											M
CO2	M	H	H											M
CO3	M	H	H											M
CO4	M	H	H											M

(L-Low, M-Medium, H-High)

UNIT - I
Shafts: Design of solid and hollow shafts for strength – For Bending, Torsion, Combinedbending andtorsion and combined bending, torsion and axial loads.
Keys: Introduction, Design of square and flat keys
Shaft Couplings: Introduction, Types of Couplings, Design of Rigid couplings – Muff, splitmuff couplings
and Flange couplings.

UNIT - II
Bearings and Lubrication: Lubrication, Types of lubrications, types of lubricants, properties of lubricants, types of Bearings, Bearing materials, Journal bearing design (using McKee's equation and Raymond and Boyd charts & tables).
Ball and Roller Bearings: Static load, Dynamic load, Equivalent radial load, selection of ball and roller bearings.

UNIT – III

Brakes: - Introduction to Brakes, Types, Analysis and design of block brakes, band brakes,block and band brakes

Clutches: Introduction to Clutches, Types, materials for clutches comparison of brakes andclutches Analysis and design of simple, multiple discs clutch and centrifugal clutches.

UNIT – IV

Spur Gears: Terminology of spur gear, standard systems of Gear Tooth, Force analysis, Geartooth failures,Lewis Equation.

Helical Gears: Terminology of helical gears, virtual number of teeth,Tooth proportions,force analysis, Lewis Equation.

I. C. Engine Components: Introduction, Design of trunk type piston and connecting rod

Text Books:

[1] V B Bhandari, "Design of machine elements", Fourth Edition, Tata McGraw Hill Education PrivateLimited, 2017.

[2] P.C. Sharma & D.K. Agarwal, "A Text Book Of Machine Design" SK Kataria & Sons, 2013

Reference books:

[1] R.S Khurmi & J.K. Gupta, "A Text book of Machine Design" Fourteeenth Edition, S.Chand & CoLtd,2015

[2] Robert L.Norton,"Machine Design- An Integrated Approach",Fifth Edition, Pearson Education, 2018.

[3] P. Kannaiah, "Machine Design", Second Edition, Scitech Publications Private Limited, 2011.

DATA BOOKS TO BE ALLOWED IN EXAMINATION:

[1] Mahadevan & Balaveera Reddy, "Design data book", - CBS Publishers

[2] V.B.Bhandari, "Design data book", Tata McGraw Hill book Co

[3] Design data book, P.S.G. College of Technology, Coimbatore

E-resources and other digital material:

[1] http://nptel.ac.in/courses/112/105/112105124/

[2] http://nptel.ac.in/courses/112/105/112105125/

[3] http://nptel.ac.in/courses/112/106/112106137/

20ME6302
HEAT TRANSFER

Course Category: Programme Core
Course Type : Theory
Prerequisites:
20ME3303 **Basic Thermodynamics**
20 ME3401 FM & HM

Credits: 3
Lecture/Tutorial/ Practice: 3 /0/ 0
Continuous Evaluation: 30
Semester end Evaluation:70
Total Marks: 100

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1: Solve one dimensional steady state heat conduction problems.

CO2: Evaluate transient conduction problems and performance of heat exchangers.

CO3: Apply the convective heat transfer principles and use empirical relations to solve convective heat transfer problems.

CO4: Apply the Laws of Radiation to compute radiation heat transfer between bodies.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSOII
CO1	M	M											M	
CO2	M	M											M	
CO3	M	M											M	
CO4	M	M											M	

(L-Low, M-Medium, H-High)

UNIT – I

Introduction:

Modes and basic laws of heat transfer - steady and unsteady heat transfer, Fourier equation, thermal resistance, thermal conductivity of materials, general heat conduction equation, initial and boundary conditions.

Steady State Conduction:

Conduction through a single and multi-layered plane, cylindrical and spherical walls, conduction with heat generation - plane wall and cylinder with uniform heat generation, critical thickness of insulation.

Heat transfer from extended surfaces:

Steady flow of heat along a rod, heat dissipation from an infinitely long fin, fin insulated at the tip, fin losing heat at the tip, fin performance, thermometric well.

UNIT – II

Transient Heat Conduction:

Transient conduction in solids with infinite thermal conductivity, time constant and response of a thermocouple. One dimensional transient heat flow in solids with finite conduction resistance using Heisler and Grober charts.

Heat Exchangers:
Classification of heat exchangers, performance analysis, overall heat transfer coefficient, fouling factor, LMTD approach, effectiveness and NTU approach.

UNIT – III
Forced Convection:
Convective heat transfer coefficient, boundary Layer concept, empirical relations for solving problems of forced convection over a flat plate, cylinder and sphere, analogybetween momentum and energy transfer, empirical relations for solving problems of forced convection through circular tubes.

Free Convection:
Free convection problems in external flows (vertical, horizontal and inclined plates, vertical and horizontal cylinders, and spheres) using empirical relations.
Concepts of pool boiling and flow boiling regimes, film-wise and drop-wise condensation.

UNIT – IV
Radiation - Processes and properties:
Introduction, absorptivity, reflectivity and transmissivity, concept of Black body, spectral and spatial energy distribution, Plank's law, Stefan Boltzmann law, Wien's displacement law, Kirchhoff's law, gray body and selective emitters, intensity of radiation, Lambert's Cosine law.

Radiation Exchange between surfaces:
Heat exchange between black bodies, shape factor algebra, heat exchange between non- black bodies– infinite parallel plates and concentric cylinders, small gray bodies, electrical network approach, radiation shields, combined radiation and convection heat transfer coefficient.

Text Books

[1] R. C. Sachdeva, "Fundamentals of Engineering Heat and Mass Transfer", New Age International (P) Limited, Publisher, 5th Multi Colour Edition, 2017.
[2] D. S. Kumar, "Heat & Mass Transfer", S. K. Kataria & Sons, 9th Edition, 2015.
[3] P. K. Nag, "Heat and Mass Transfer", Tata McGraw Hill, 2011.

Reference Books

[1] N. Ozisik, "Heat Transfer - A Basic Approach", TMH, 1985.
[2] J. P. Holman, "Heat Transfer", Tata McGraw Hill, 2008.
[3] lncropera and Dewitt, "Introduction to Heat Transfer", John Wiley, 2011.

E-Resources and other digital material

- IIT video lecturers (NPTEL): https://nptel.ac.in/courses/112101097/
- https://www.grc.nasa.gov/www/k-12/airplane/heat.html
- http://study.com/academy/lesson/heat-transfer-phase-changes.html
- https://www.tes.com/teaching-resource/heat-transfer-convection-11810446

NOTE: Heat and Mass Transfer Data Book is allowed in the examinations.

20HS6103
ENGINEERING ECONOMICS AND MANAGEMENT

Course Category: Humanities &Social Sciences
Course Type : Theory
Prerequisites:--

Credits: 2
Lecture/Tutorial/ Practice: 2 /0/ 0
Continuous Evaluation: 30
Semester end Evaluation:70
Total Marks:100

Course Outcomes:
Upon successful Completion of the course, the student will be able to:

CO1: Understand various forms of organizations and principles of management.
CO2: Understand the various aspects of business economics.
CO3: Perceive the knowledge on Human resources and Marketing functions.
CO4: Evaluate various alternatives economically.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSOII
CO1	M											M		M
CO2	M				H							M		M
CO3	M											M		M
CO4	M				H							M		M

(L-Low, M-Medium, H-High)

UNIT - I
Forms of Business Organization: Salient Features of Sole Proprietorship, Partnership, Joint Stock Company, Co-operative Society and Public Sector.
Management: Introduction to Management,Functions of Management, Principles of Scientific Management, Modern Principles of Management.

UNIT - II
Introduction to Economics: Introduction to Basic Economic Concepts, Utility Analysis: Marginal Utility and Total Utility, Law of Diminishing Marginal Utility, Law of Equi Marginal Utility.
Demand Analysis: Theory of Demand: Demand Function, Factors Influencing Demand, Demand Schedule and Demand Curve, Shift in Demand, Elasticity of Demand: Elastic and Inelastic Demand, Types of Elasticity.
Supply Analysis: Supply Schedule and Supply Curve, Factors Influencing Supply, Supply Function.

UNIT – III

Human Resource Management: Meaning and difference between Personnel Management and Human Resource Management, Functions of Human Resource Management.

Marketing Management: Concept of Selling And Marketing – Differences, Functions of Marketing, Product Life Cycle, Concept of Advertising, Sales Promotion, Types of Distribution Channels, Marketing Research, Break-Even Analysis.

UNIT – IV

Financial Management: Functions of Financial Management, Time value of money with cash flow diagrams, Concept of Simple and Compound Interest.

Depreciation: Causes of depreciation, Factors influencing depreciation, common methods of Depreciation: Straight Line Method, Declining Balance Method, Sum of Year's Digits Method – Problems.

Economic Alternatives: Methods of Evaluating Alternatives under Present worth method, Future worth method, Annual Equivalent method - Problems.

Text Books:

[1] M. Mahajan*Industrial Engineering and Production Management* Dhanpat Rai Publications2nd Edition.

[2] Martand Telsang" Industrial & Business Management" S.Chand publications

Reference books:

[1] R.Paneerselvam "Production and Operations Management" PHI

[2]Philip Kotler & Gary Armstrong "Principles of Marketing" ,pearson prentice Hall,New Delhi,2012 Edition.

[3] IM Pandey, "*Financial Management*" Vikas Publications 11th Edition

[4] B.B Mahapatro, ***"Human Resource Management".***,New Age International ,2011

E-resources and other digital material:

[1] https://www.toppr.com/guides/fundamentals-of-economics-and-management/supply/supply-function/

[2] https://keydifferences.com/difference-between-personnel-management-and-human-resource-management.html

[3] http://productlifecyclestages.com/

[4]https://speechfoodie.com/cash-flow-diagrams/

20ME6404 A
FINITE ELEMENT METHOD

Course Category: Programme Elective **Credits**: 3
Course Type: Theory **Lecture/Tutorial/ Practice**: 3 /0/ 0
Prerequisites: 20 ME3302 -Mechanics of Materials, **Continuous Evaluation**: 30
20ME6352 -Heat Transfer **Semester End Evaluation**:70
Total Marks:100

Course Outcomes:
Upon successful Completion of the course, the student will be able to:
CO 1: Understand the philosophy of FEM and solve 1-D bar problems.
CO 2: Apply FEM to planar truss and beam problems.
CO 3: Apply FEM to 2-D plane-stress, plane-strain and axisymmetric problems, and perform 1-D numerical integration.
CO4: Apply FEM to 1-D and 2-D steady state heat transfer problems.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSOII
CO1	M	H	L		M								M	M
CO2	M	H	L		M								M	M
CO3	M	H	L		M								M	M
CO4	M	H	L		M								M	M

(L-Low, M-Medium, H-High)

UNIT – I
Fundamental concepts: Introduction, stresses and equilibrium, boundary conditions, strain-displacement relations, stress-strain relations for plane stress, plane strain, 2-D axisymmetric and three-dimensional cases, potential energy and equilibrium; the Rayleigh-Ritz method, Galerkin's method.

Basic concepts of FEM and one dimensional problems: Fundamental concepts, Finite Element Modeling, Coordinates and Shape functions, The Potential Energy Approach, Element Stiffness Matrix and Element Load Vector, Assembly of the global stiffness matrix and load vector, Properties of global stiffness matrix, The Finite Element equations; Treatment of boundary conditions, Examples of Axially Loaded members.

UNIT – II
Plane trusses: Introduction, Plane Trusses, Local and Global Coordinate systems, Element Stiffness Matrix, Treatment of boundary conditions, Stress Calculations, Example of plane Truss with three members.

Planar beams: Introduction, Potential Energy Approach, Element stiffness matrix for twonode planar beam element, load vector, boundary conditions, simple beam problems.

UNIT – III

Two dimensional problems: Introduction, Plane Stress and Plane Strain, Finite Element Modeling, Constant Strain Triangle (CST); Potential Energy Approach, derivation of Element Stiffness matrix, derivation of force vector for body forces and linearly varying pressure load, Problem modeling and boundary conditions. simple problems.

Finite element formulation for an axisymmeric linear triangular element, Potential Energy Approach, Derivation of element stiffness matrix, derivation of force vector for body forces and uniformly distributed pressure load, simple problems. Numerical **integration:** One- dimensional Integrals using one-point formula, One-dimensional Integrals using two-point formula.

UNIT – IV

One-dimensional steady state heat transfer: Introduction, one dimensional steady state heat conduction, boundary conditions: specified temperature, convection and heat flux, Galerkin's approach for heat conduction, one-dimensional steady state heat transfer in thin fins. Simple problems.

Two-dimensional steady state heat transfer: Two dimensional steady state heat conduction, boundary conditions: specified temperature, convection and heat flux,Galerkin's approach, simple problems with maximum 3 unknowns.

Text books:

[1] Introduction to Finite Elements in Engineering by T. R. Chandrupatla and A. D. Belegundu, 3rd Edition, PHI Learning Private Limited, 2011.

Reference books:

[1] Singiresu S. Rao, "The Finite Element Method in Engineering", Fifth edition, Butterworth-Heinemann, 2011.
[2] Applied Finite Element Analysis – Larry J. Segerlind, John Wiley and Sons, Second Edition, 1984
[3] Finite Element Analysis by P. Seshu, PHI Learning Private Limited, 2008.

E-resources and other digital material:

[1] https://en.wikipedia.org/wiki/Finite_element_method
[2] http://reference.wolfram.com/applications/structural/FiniteElementMethod.html
[3] https://www.youtube.com/watch?v=oNqSzzycRhw
[4] https://www.youtube.com/watch?v=NYiZQszx9cQ&list=PLA4CBD0C55B9C3878

20ME6404 B
MECHANICAL VIBRATIONS

Course Category: Humanities &Social Sciences
Course Type : Theory
Prerequisites: 20ES2104 F-Engineering Mechanics, 20ME4303 -Machine dynamics

Credits: 3
Lecture/Tutorial/ Practice: 3 /0/ 0
Continuous Evaluation: 30
Semester end Evaluation:70
Total Marks:100

Course Outcomes:
Upon successful Completion of the course, the student will be able to:

CO1: Analyze single degree of freedom damped and un-damped systems executing free and forced Vibrations.
CO2: Analyze single degree of freedom forced vibration systems.
CO3: Interpret the concepts of un-damped two-degrees of freedom systems and vibration absorbers
CO4: Analyze multi-degree of freedom systems natural frequencies and mode shapes.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1	H	H	M											M
CO2	H	H	M											M
CO3	H	H	M											M
CO4	H	H	M											M

(L-Low, M-Medium, H-High)

UNIT - I

Free vibrations of un-damped and damped single DOF systems: Overview of un-damped single DOF systems, Different types of damping, Free vibrations with viscous damping, Over-damped system, Critically-damped system, Under-damped system, Logarithmic decrement.

Forced vibrations of single DOF systems: Introduction, Forced vibrations with constant harmonic excitation, steady state vibrations.

UNIT - II

Applications of Forced vibrations of single DOF systems: Forced vibrations with rotating and reciprocating unbalance, Forced vibrations due to excitation of the support, Energy dissipated by damping, Vibration isolation and transmissibility.

Critical speeds of shafts: Critical speed of a light shaft having a single disc without damping, critical speed of a light shaft having a single disc with damping.

UNIT – III

Un-damped two-degrees of freedom systems: Natural frequencies of rectilinear and torsional systems, Semi-definite system, generalized coordinates and co-ordinate coupling.

Vibration absorbers: un-damped dynamic vibration absorber, centrifugal pendulum absorber.

UNIT – IV

Multi-Degree of freedom systems: Free vibrations- equations of motion, Influence coefficients, Natural frequencies and mode shapes (Eigen values and Eigenvectors). Orthogonal properties if normal modes.

Torsional Vibrations of Multi Rotor Systems: Vibrations of geared systems

Text Books:

[1] Mechanical Vibrations by G. K. Grover, New Chand & Bros, 8th edition, 2009.
[2] Mechanical Vibrations by Dr.R.K.Singal, S.K.kataria& Son, First edition, 2010-2011.

Reference books:

[1] Mechanical Vibrations by Dilip Kumar Adhwarjee, Laxmi Publications, 1st Edition, 2007
[2] Mechanical Vibrations by V.P.singh, DhanpatRai& Co. (P) Ltd, Delhi, 4th edition, 2015
[3] Mechanical Vibrations by Singiresu S Rao, Prentice Hall, Fifth Edition, 2011

E-resources and other digital material:

1. http://nptel.ac.in/courses/112103112/1
2. http://freevideolectures.com/Course/2684/Mechanical-Vibrations

20ME6404 C
ADVANCED MECHANICS OF MATERIALS

Course Category: Programme Elective
Course Type : Theory
Prerequisites:
20ES1104C Engineering Mechanics - I
20ME3302 Mechanics of Materials

Credits: 3
Lecture/Tutorial/ Practice: 3 /0/ 0
Continuous Evaluation: 30
Semester end Evaluation:70
Total Marks:100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Determine stress, strain, and deformations for statically in-determinate bars.

CO2: Construct Shear force and bending moment diagrams for in-determinate beams.

CO3: Estimate stresses and strains for pressure vessels & rotating discs.

CO4: Locate shear centers and evaluate stresses in curved beams.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1	H	L	M											M
CO2	M	M	H											M
CO3	M	M	H											M
CO4	M	M	H											M

(L-Low, M-Medium, H-High)

UNIT – I

Statically Indeterminate Bars: Introduction, Analysis of bars of composite sections, Thermalstresses in composite bars.

Starin Energy and Energy Principles: Introduction, strain energy of axial loaded members, gradually applied load, suddenly applied load, impact loading.

UNIT - II

Fixed Beams: Introduction, Shear force and bending moment diagrams of fixed beams, Analysis by the differential equations of the Deflection curve, Slope and deflections by integration of bending moment equations, Macaulay's Method.

Continuous Beams: Introduction, Clapeyron's theorem of three moments, Shear force and bending moment diagrams of continuous beams, Beams with overhang and fixed ends.

UNIT – III

Thick Cylindrical and Spherical Pressure Vessels: Stresses in a thick cylindrical shell, Stresses in compound thick cylinders, Initial difference in radii at the junction of the compound cylinder for Shrinkage, Stresses in thick spherical shells.

Centrifugal Stresses: Introduction, Rotating Ring, Rotating Disc, Rotating Disc of uniform strength.

UNIT – IV

Curved Beams: Stresses in Beams of small and large initial curvature, The Winkler-Bach theory, Stresses in Crane Hook with trapezoidal cross-section.

Shear Center: Shear centre, determination of shear centre for channel section, determination of shear centre for I – section.

Text Books:

[1] R.K.Bansal, "Strength of Materials" Fifth edition, Laxmi Publishers, 2012

[2] Dr. Sadhu Singh,"Strength of Materials", Ninth edition, Khanna Publishers, 2007.

Reference books:

[1] R.K. Rajput,"Strength of Materials",First Edition, S.Chand & Company, 2006.

[2] S.S.Rattan, "Strength of Materials", Second Edition,Tata McGraw Hill Education Private Limited, 2012.

[3] Surendra Singh,"Strength of Materials", First Edition, S.K.Kataria & Sons.

E-resources and other digital material:

[1] Prof. S.K.Maiti, IIT Bombay, Advanced Strength of material, [English], Web
https://nptel.ac.in/courses/112101095/
http://www.nptelvideos.in/2012/12/advanced-strength-of-materials.html

[2] James M. Gere and Barry J. Goodno, "Mechanics of Materials", Eighth edition, CENGAGE Learning, 2009
https://www.academia.edu/31679740/Mechanics_of_Materials_8th_Edition

20ME6205 A
MECHATRONICS

Course Category: Open Elective/Job oriented Elective **Credits**: 3
Course Type : Theory **Lecture/Tutorial/ Practice**: 2/ 0/ 2
Prerequisites : **Continuous Evaluation**: 30
20ME3305-Kinematics of Machines **Semester end Evaluation**: 70
20ES4102 – Basic Electronics **Total Marks:** 100

Course Outcomes:
Upon successful completion of the course, the student will be able to:
CO1: Understand the working principles of various Sensors and Transducers.
CO2: Develop system models & transfer function for Mechanical, Electrical, Fluid&Thermal systems.
CO3: Compare different controllers such as Proportional, Derivative, Integral, PI, PD and PID.
CO4: Analyze various case studies related to Mechatronics systems.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSOII
CO1	M	M			M				M					M
CO2	H	M			M				M					M
CO3	H	M			H				H					M
CO4	M	M			M				H					M

(L-Low, M-Medium, H-High)

UNIT – I
Introduction to Mechatronics
Sensors & Transducers: Introduction, performance terminology, Classification of sensors: Potentiometer sensor, strain gauged element, Capacity element, LVDT, Optical Encoders, Tachogenerator and stain gauge load cell, Selection of sensors.

Signal Conditioning: Introduction data acquisition – Quantizing theory, Analog to digital conversion, digital to analog conversion.

UNIT – II
Basic System Models: Modeling of one and two degrees of freedom Mechanical, Electrical, Fluid and thermal systems. Block diagram representations for these systems.

System Transfer functions: Laplace transform, Transfer function of First order systems, Second order systems, Systems in series, Systems with feedback loops.
UNIT – III
Closed loop controllers: Continuous and discrete processes, control modes, Two-step, Proportional, Derivative, Integral, PID controllers.

Digital logic: Logic gates, Applications of logic gates: digital comparator, coder. SR flip-flop.

UNIT – IV

PLC : Introduction, basic structure, I/P, O/P, processing, programming, ladder diagrams, timers, internal relays and counters, data handling, analogue input and output, selection of PLC.

Design: Designing Mechatronics systems, possible design solutions, case studies of Mechatronics systems – i) Car park barriers ii) Car engine management iii) Bar code- reader

Text Books:

[1] Mechatronics: Electronic control systems in Mechanical and Electrical Engineering by W. Bolton, PEARSON , 6th Edition, 2015.

[2] Introduction to Mechatronics – David and Alcaitore Michael B.Histand TMH, 4th Edition, 2006.

Reference books:

[1] Mechatronics by N P Mahalik,1st Edition, 2003, TMH.

[2] Mechatronics System design by Devdas Shetty and Richard A Kolk, Cengage Learning, 2nd edition.

E-resources and other digital material:

[1] www.engr.colostate.edu/~dga/mechatronics/resources.html

[2] www.NI.com/

[3] www.cambridgemechatronics.com/

[4] www.pdf-free-download.com/mechatronics-labs.pdf

20ME6205B
ADDITIVE MANUFACTURING

Course Category: Open Elective/Job Oriented Elective **Credits**: 3
Course Type : Theory **Lecture/Tutorial/ Practice**: 2/0/2
Prerequisites: 20ES1105 Engineering Graphics **Continuous Evaluation**: 30
Semester end Evaluation: 70
Total Marks: 100

Course Outcomes:
Upon successful Completion of the course, the student will be able to:

CO1: Recognize the importance and application of AM models in engineering design
CO2: Develop various layered models using different AM methods
CO3: Illustrate the methodology to manipulate the STL file for improved part accuracy
CO4: Understand the applications of AM

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1					L				L					M
CO2					H				M					H
CO3					H				H					H
CO4					H				H					H

(L-Low, M-Medium, H-High)

UNIT-I

Introduction: Additive Manufacturing, AM Parts Used, Generic AM Process, Distinction between AM and CNC Machining, Prototype Fundamentals, Historical Development, Fundamentals of RP, Advantages of RP, Classification of RP processes, Steps in AM process Chain.

UNIT - II

Stereo Lithography System- Process, Principle, Strengths and weaknesses, Applications.

Solid Ground Curing (SGC)- Process, Principle of operation, Strengths and Weaknesses, Applications.

Laminated Object Manufacturing (LOM)- Principle of Operation, LOM materials, Process, Strengths and weaknesses, Applications,

UNIT –III

Fused Deposition Modelling (FDM)-Principle, process, Strengths and weaknesses, Applications.

Laser Engineering Net Shaping (LENS): Principle, process , Strengths and weaknesses , Applications

Selective Laser Sintering(SLS): Principle, process , Strengths and weaknesses , Applications

UNIT IV

Software for RP: STL format, STL file problems, Consequences of building valid and invalid tessellated models, STL file manipulation.

Applications: Applications in Design, Applications in Engineering, Analysis and Planning, Designand Production of Medical Devices.

Text Books:

[1] C K Chua, K F LEONG, C S LIM , Rapid prototyping 3rd edition, Principles & Application, NAnyang Technological University, Singapore 2010
[2] Ian Gibson. David Rosen, Brent Stucker – "Additive Manufacturing Technologies, 3D Printing, Rapid Prototyping, Direct Digital Technologies", Second Edition, Springer, 2015.

Reference books:

[1] Andreas Gebhardt, Jan- Stefen Heotter," Additive Manufacturing. 3D printing for Prototyping and Manufacturing", Hanser Gardner Publications, 2016.
[2] Bandyopadhyay, Amit, Bose, Susmita. "Additive Manufacturing", CRC Press, 2016.

E-resources and other digital material:

Web Resources:

[1] http://www.additive3d.com/rp_int.htm
[2] https://www.rolanddga.com/applications/rapid-prototyping
[3] http://www.emeraldinsight.com/journal/rpj
[4] http://additivemanufacturing.com/
[5] http://www.eos.info/additive_manufacturing/for_technology_interested

NPTEL Videos:

[2] https://www.youtube.com/watch?v=oMQWGBgNCtg
[3] https://www.youtube.com/watch?v=s3gHHeD6cv8
[4] https://www.youtube.com/watch?v=BUfh5wxj3qA
[5] https://www.youtube.com/watch?v=PDLOmoQj4H0

20ME6351
SIMULATION AND ANALYSIS LAB

Course Category: Programme Core **Credits**:1.5
Course Type : Laboratory **Lecture/Tutorial/ Practice**: 0 /0/ 3
Prerequisites : Engineering Mechanics **Continuous Evaluation**:30
Mechanics of Materials **Semester end Evaluation**:70
Total Marks:100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Understand fundamental concepts of finite element methods

CO2: Simulate and analyze stepped bars

CO3: Simulate and analyze plane trusses

CO4: Simulate and analyze beams

CO5: Simulate and analyze 1-D heat transfer.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1	L		M		H							M		M
CO2	L		M		H							M		M
CO3	L		M		H							M		M
CO4	L		M		H							M		M
CO5	L		M		H							M	M	

(L-Low, M-Medium, H-High)

Course Content:

Finite Element Analysis Package (ANSYS)

1. Fundamental Concepts in Finite Element Methods with an example of stepped bar.
2. ANSYS ® Graphical User Interface.
3. Two step bar analysis.
4. Multi step and different material determinate and in-determinate bars analysis.
5. Finite Element Method for Plane truss analysis.
6. Simulation of Plane truss.
7. Finite Element Method for analysis of beams.
8. Analysis of beams.
9. Finite Element Method for 1-D heat transfer.
10. Analysis of 1-D heat transfer problems

20ME6352
HEAT TRANSFER LABORATORY

Course Category: Programme Core **Credits**:1.5
Course Type: Laboratory **Lecture/Tutorial/Practice**:0/0/3
Prerequisites: **Continuous Evaluation**: 30
Basic Thermodynamics, Fluid Mechanics, Heat Transfer **Semester end Evaluation:** 70
Total Marks: 100

Course Outcomes:
At the end of the course, student will be able to
CO1: Evaluate steady and unsteady heat conduction.
CO2: Evaluate heat transfer by convection and combined modes.
CO3: Determine Stefan Boltzmann constant and Emissivity of a grey body.
CO4: Determine COP of Refrigeration and Air conditioning systems.

Contribution of Course Outcomes towards the achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	L2	PSOI	PSO II
CO 1			M	H	L								M	
CO 2			M	H	L								M	
CO 3			M	H	L								M	
CO 4			M	H	L								M	

(L-Low, M-Medium, H-High)

Experiments:

1. Measurement of Thermal conductivity of metal rod
2. Measurement of Thermal conductivity of insulating powder
3. Heat transfer through a lagged pipe apparatus
4. Heat transfer from pin fin in forced convection
5. Heat transfer by forced convection through a duct
6. Heat transfer by natural convection over a cylindrical surface
7. Heat transfer in Parallel flow and Counter flow heat exchangers
8. Heat transfer in Cross flow heat exchanger
9. Determination of Stefan Boltzmann constant
10. Measurement of Emissivity of a Grey surface
11. Determination of COP of Vapour compression refrigeration system
12. Determination of COP of an Air conditioning system
13. Estimation of Transient heat conduction

NOTE: Heat and Mass Transfer Data Book is allowed in the examination.

20HS6153
ENGLISH COMMUNICATIONS SKILL LAB

Course Category : Institutional Core **Credits:** 1

Course Type : Lab **Lecture/Tutorial/Practice:** 0/0/2

Prerequisites : Technical English &Communication skills -17HS1205 **Continuous Evaluation:** 30

Semester End Evaluation: 70

Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Be proficient in pronunciation of speech sounds including accentuation

CO2: Enhance the awareness of the elements of listening comprehension

CO3: Develop the abilities of rational argumentation and skills of public speaking

CO4: Be aware of the elements of professional communication

CO5: Be exposed to the items of various competitive exams

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO 1				H										
CO 2				H										
CO 3				H										
CO 4				M										
CO5				M										

(L-Low, M-Medium, H-High)

UNIT I

Elements of Spoken Expression and processes of Listening comprehension:

- Speech Mechanism
- Articulation of vowels and consonants
- Patterns of Accentuation
- Types and processes of Listening comprehension

UNIT II:

Patterns of Substantiation and Refutation in Public Speaking:

- Group Discussion
- Pyramid Discussion
- PNI
- Seminar Talk and Power Point Presentation

UNIT III: Professional Communication:

- Self-Affirmation
- Advanced Composition including Memo and e-mail
- Résumé Preparation
- Elements of Non-Verbal Communication

Text Books:

[1] Martin Cutts, Oxford Guide to Plain English, 7th Impression, OUP, 2011
[2] Exercises in Spoken English, Prepared by Department of Phonetics and Spoken English, CIEFL, OUP, 21st Impression, 2003

Reference Books:

[1] Stephen R Covey, The 7 Habits of Highly Effective people, II edition, (Pocket Books) Simon & Schuster UK Ltd, 2004
[2] Eclectic Learning Materials offered by the Department

E-resources and other digital material

[1] ODll Language Learner's Software, 27-6-2012 Orell Techno Systems ,
[2] Visionet Spears Digital Language Lab software Advance Pro , 28-01-2015
[3] www.natcorp.ox.ac.uk, British National Corpus, accessed on 28-11-2017

20TP6106
QUANTITATIVE APTITUDE

Course Category: Institutional Core
Course Type : Learning by Doing
Prerequisites:

Credits: 1
Lecture/Tutorial/ Practice: 0 /0/ 2
Continuous Evaluation: 100
Semester end Evaluation: 00
Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Effectively organize, summarize and present information in quantitative forms including tables
CO2: Be able to use mathematical based reasoning and be able to evaluate alternatives and make decisions
CO3: Be able to think and reason logically and critically in any given situation
CO4: Application of logical thinking to solve problems and puzzles in qualifying exams for companies and in other competitive exams

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1	M													
CO2				M										
CO3	M													
CO4									M					

(L – Low, M- Medium, H – High)

UNIT I:

1. Number system
2. HCF & LCM,
3. Average,
4. Percentages,
5. Profit & Loss

UNIT II:

1. Ratio & Proportion,
2. Partnership,
3. Chain Rule,
4. Time & Distance,
5. Time & Work

UNIT III:

- Pipes & Cistern,
- Problems on Trains,
- Problems on boats &Steams,
- Allegation,
- Simple interest and compound interest.

UNIT IV:

- Area, Volume and Surface areas,
- Races & Games of skills,
- Calendar & Clock,
- Stocks & Shares,
- Permutations & Combination,
- Probability.

Learning Resources: Quantitative Aptitude by R.S.Aggarwal

20ME6554
MINI PROJECT - I

Course Category: Project
Course Type: Practical
Prerequisites:

Credits: 1
Lecture - Tutorial - Practice: 0/0/2
Continuous Evaluation: **Semester end** 30
Evaluation: 70
Total Marks: 100

Course Outcomes: At the end of the course the students will be able to

CO1: Identify the problem, define objectives and scope of the project work
CO2: Carryout Team work.
CO3: Prepare and present a comprehensive report of the project work.
CO4: Apply the principles of Thermal Engineering to solve problems .
CO5: Solve Engineering problems using the concept of design and manufacturing.

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSOII
CO1									H					
CO2				H										
CO3							H	M						
CO4	M	M			H			M			M		H	
CO5	M	M			H			M			M			H

20MC6107
BIOLOGY FOR ENGINEERS

Course Category: Institutional core
Course Type : Theory
Prerequisites:

Credits: 0
Lecture/Tutorial/ Practice: 2 /0/ 0
Continuous Evaluation: 100
Semester end Evaluation:00
Total Marks:100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Explain the fundamental principles of Biology that lead to major discoveries
CO2: Identify the functions of different types in bio-molecules
CO3: Explain mechanisms underlying the working of molecular biological processes including enzyme catalysis, metabolic pathways, gene expression
CO4: Understand metabolism to analyze biological processes

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSOII
CO1	M					L			L					
CO2	M					L			L					
CO3	M					L			L					
CO4	M					L			L					

(L – Low, M- Medium, H – High)

Course Content

Unit-I Introduction and Classification of Living organisms

Introduction:

Fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Biology as an independent scientific discipline. Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor.

Classification:

Classification of living organisms based on (a) Cellularity- Unicellular or multicellular(b)Ultrastructure- prokaryotes or eukaryotes. (c) Energy and Carbon utilization - Autotrophs, heterotrophs, lithotrophs

(d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitat- acquatic, terrestrial (e) Molecular taxonomy- three major kingdoms of life.

Unit-II Biomolecules and Enzymes

Biomolecules:

Biomolecules: Structures of sugars (Glucose and Fructose), starch and cellulose. Nucleotides and DNA/RNA. Amino acids and lipids. Proteins- structure and functions- as enzymes,

transporters, receptors and structural elements.

Enzymes:

Enzyme classification. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters.

Unit-III

Genetics and Gene information Transfer Genetics:

"Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Concepts of recessiveness and dominance. Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring.

Information Transfer:

DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Unit-IV Metabolism and Microbiology

Metabolism:

Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. ATP as an energy currency. Breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions.

Microbiology:

Concept of single celled organisms. Concept of species and strains. Identification andclassification of microorganisms. Growth kinetics. Ecological aspects of single celled organisms. Microscopy.

Text Books:

[1] Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S.A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd

[2] Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons

[3] Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company

[4] Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher, Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

E-resources and other digital material:

[1] https://bee.cals.cornell.edu/sites/bee.cals.cornell.edu/files/shared/documents/Car eer_Bee_Final-for Web.pdf

[2] https://www.teachengineering.org/subjectareas

SEVENTH SEMESTER

20ME 7301
COMPUTER AIDED MANUFACTURING

Course Category: Program Core **Credits:** 3
Course Type: Theory& Practice **Lecture/Tutorial/ Practice:** 2/ 0/ 2
Prerequisites: 20ME1104C - Engineering Mechanics-I **Continuous Evaluation:** 30
20ME5303– Machine Tools and Metal Cutting **Semester End Evaluation:** 70
Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Acquire the concepts of NC machine tools, their classification, applications, Advantages & Disadvantages

CO2: Understand the concepts of CNC, DNC, Adaptive control and Manual part programming

CO3: Know the fundamentals of A P T Language and Group Technology

CO4: Distinguish the concepts of CAPP, FMS, CIMS and Industry 4.0

Contribution of Course outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1	M		M											M
CO2	M	M	M											M
CO3	M	M	M											M
CO4	M		M											M

(L – Low, M - Medium, H – High)

UNIT - I

Numerical Control in Production Systems: Introduction, Historical background, role of computers in manufacturing, components of NC Systems, Need for numerical control, Classification of NC systems, NC coordinate system, NC Applications, Advantages and disadvantages of NC machines, Recent trends in NC systems.

UNIT - II

Computer Control of NC Machines: Introduction, Principles of operation of CNC, Features of CNC, Developments in CNC systems, Direct Numerical Control (DNC), Types of DNC, Advantagesof CNC and DNC, Adaptive Control Machining. Manual Part Programming: Introduction, Manual Part Programming, Codes & Concepts, Cutter Length Compensation, Cutter Radius Compensation, Canned Cycles, Simple Programming Examples.

UNIT - III

Computer Assisted Part Programming: Advantages of Computer Assisted Part Programming, APT Language, Geometry, Motion Commands, Macros, Simple Programming Examples. Group Technology: Introduction, Part Families, Parts Classification and Coding, Different parts classification and coding systems, Cellular Manufacturing, Composite Part Concept, Benefits of Group Technology.

UNIT – IV:

Computer Aided Process Planning: Types of Computer Aided Process Planning, Retrieval type of Process Planning Systems, Generative Process Planning Systems, Benefits of CAPP.

Flexible Manufacturing Systems: Introduction, Types of Flexible Manufacturing Systems, FMSLayout configurations, Automated Guided Vehicle Systems and its working principles, control and safety aspects of A G V S, FMS Applications and Benefits, Introduction to Computer Integrated Manufacturing Systems (CIMS)and Industry 4.0.

Course content for Practice part

Manual Part Programming Turning:

a. Step turning
b. Taper turning
c. Profile turning

Milling:

a. Linear & Circular interpolation
b. Mirror imaging using sub program
c. Pocketing
d. Tool radius compensation
e. Drilling of holes

Text Books:

[1] P. N. Rao, T. K. Kundra& N. K. Tiwari, "Numerical Control & Computer Aided Manufacturing", Tata Mc- Graw Hill Publishers, New Delhi, 2008.
[2] Mikell P. Groover, "CAD/ CAM", Prentice Hall of India, 3rd Edition, Delhi, 1995.

Reference books:

[1] Mikell P. Groover, "Automation, Production Systems and CIM", Prentice Hall of India, 2nd Edition, New Delhi, 1995.
[2] YoramKoren, " Computer Control of Manufacturing Systems", Mc- Graw Hill International Publishers, Singapore, 2010.
[3] N. K. Mehta, "Machine Tool Design and Numerical Control", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

E-resources and other digital material:

[1] http://nptel.iitm.ac.in
[2] http://www.engr.sjsu.edu
[3] http://web.iitd.ac.in
[4] http://www.enotes.com/computer-aided-design-cad-cam
[5] www.britannica.com/EBchecked/topic/130575/computer -aided-manufacturing
[6] http://en.wikipedia.org/wiki/Computer-aided_design#overview

20ME7402 A
METROLOGY

Course Category: Programme Elective
Course Type : Theory
Prerequisites:
Basics of Mechanical Engineering
Physics for Engineers

Credits: 3
Lecture/Tutorial/ Practice: 3/0/0
Continuous Evaluation: 30
Semester end Evaluation: 70
Total Marks:100

Learning Outcomes: At the end of the course the students will be able to

CO1: Evaluate various devices for linear and angular measurements.

CO2: Understand the limits, fits, tolerances, interchangeability and gauge design.

CO3: Acquire knowledge on comparators and surface roughness measuring instruments

CO4: Demonstrate the interferometer, CMM and form measuring instruments.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1	H													M
CO2	H	M	M											M
CO3	M													M
CO4	M													M

(L-Low, M-Medium, H-High)

UNIT – I:

Metrology: Introduction, scope, activities, objectives, categories, need of inspection, accuracy and precision, factors effecting accuracy.

Standards of Length and Angle: End standards, line standards, wavelength standards, slip gauges, angle gauges, sine bars, and spirit levels.

UNIT – II:

Limits, fits and gauges: Theory of limits, Fits, Tolerances and their selection, Hole Basis and shaft basis systems, IS system of limits & fits, Simple problems. Interchangeability, Selective Assembly, Limit gauges, Taylor's Principle of limit gauging, plug gauges, Ring gauges and their applications.

UNIT – III:

Comparators: Mechanical comparators- Read comparator, Sigma comparator, Solex pneumaticgauge, Electrical & Electronic comparator, projectors, Tool Maker's Microscope, Auto collimator and angle dekkor

Measurement of surface finish: Surface texture, roughness, waviness, Indian standard terminology, Various methods of measuring surface finish, Tomlinson surface meter and Taylor Hobson Talysurf.

UNIT – IV:

Advances in Metrology: Laser interferometry, Michelson Interferometer, Single frequency DC Interferometer, AC Laser Interferometer, AC Laser Interferometer, Basic concept of CMM, types of CMM, constructional features, and applications.

Form Measurement: Principles and methods of straightness, flatness measurement, thread measurement and gear measurement.

Text books:

[1] Metrology - R.K.Jain, Twenty First Revised edition. 2015, Khanna publishers

[2] A Textbook of Metrology by M Mahajan, 2nd edition 2011, Dhanpath Rai Publications.

[3] Engineering Metrology by Vinod Thombre Patil, , First edition 2018, Nirali Prakasan.

Reference Books:

[1] Engg.Metrology – D.M.Antony

[2] A Text book of Engg.Metrology – I.C.Gupta., 7th Edition, Dhanapathrai publications

[3] Hand Book of Industrial Metrology – ASTME.

[4] Mechanical Measurements by T. G. Beckwith, Roy D. Marangoni, John H. Lienhard V.6th edition.2009, Pearson Prentice Hall

E-resources and other digital material:

[1] http://www.metrologymetro.com

[2] http://www. emtoolbox.nist.gov/.

[3] http://en.wikipedia.org/wiki/Metrology#Basics

20ME7402 B
THEORY OF METAL CUTTING

Course Category: Programme Elective
Course Type : Theory
Prerequisites:
20 ME 3304 - Manufacturing Processes
20ME5303 - Machine Tools and Metal Cutting

Credits: 3
Lecture/Tutorial/ Practice: 3 /0/ 0
Continuous Evaluation: 30
Semester end Evaluation:70
Total Marks:100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Explicate the ASA, ORS and NRS systems of tool geometry and derive their interrelationships.

CO2: Develop the relations for chip reduction coefficient, shear angle, shear strain, forces, power and specific energy with orthogonal cutting.

CO3: Analyze thermal aspects and tool wear relationships in orthogonal cutting.

CO4: Select cutting tool material for improving tool life and understand the mechanics of multipoint machining.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1	M		M											M
CO2	M		M											M
CO3	M		M											M
CO4	M		M											M

(L-Low, M-Medium, H-High)

UNIT – I

Introduction: Classification of Mfg. Processes, History of Machining, Scope and Significance of Machining.

Geometry of Cutting Tools: Geometry of single-point cutting tool: Tool-in hand system, ASA system, Significance of various angles of single point cutting tools, Orthogonal Rake System (ORS), problems on Conversions between ASA and ORS systems, Normal Rake System (NRS) & relation with ORS.

UNIT – II

Mechanics of Machining Processes: Orthogonal and Oblique cutting, Mechanics of Chip formation: Types of chips, chip-breakers, Chip reduction coefficient, shear angle, shear strain, Built- Up-Edge and its effect in metal cutting.

Merchant's analysis of the metal cutting process: Various forces, power and specific energy in cutting, Problems on Tool Geometry and Mechanics of Machining.

Theories of Metal Cutting: Ernst & Merchant, theory, Modified Merchant's theory, Lee & Shaffer Theory, Chip-tool Natural Contact Length – Hahn's Analysis Stress distribution at Chip-Tool Interface – Zorev's Analysis, Machining with controlled contact cutting, Chip breakers.

UNIT – III

Thermal aspects in Machining: Sources of heat generation, Effects of temperature, Determination of cutting temperature using analytical methods, Determination of cutting temperature using experimental methods, Methods of Controlling Cutting Temperature.

Tool wear, Tool life, Machinabilty and Machining Economics: Wear Mechanisms, Types of tool wear, Tool Life and Machinability, A brief treatment for single pass turning operations, Problems on Economics of Machining.

UNIT – IV

Cutting Tool Materials: Desirable Properties of tool materials, Characteristics of Cutting Tool Materials, Indexable inserts, Coated tools.

Mechanics of Multipoint Machining processes: Drill Geometry & Mechanics of Drilling Process, Geometry of Milling Cutters and Mechanics of Milling process, Mechanics of Grinding (plunge grinding and surface grinding), Grinding wheel wear.

Oblique Cutting: Mechanics of Oblique Cutting.

Text Books:

[1] M. C. Shaw, Metal cutting-Principles and Practices, Cambridge University press. 2005
[2] Rao PN, Manufacturing Technology–Metal Cutting and Machine Tools, 3/e, TMH, New Delhi, 2013.
[3] Bhattacharya A, Metal Cutting: Theory and Practice, New Central Book Agency, Kolkata, 2007

Reference books:

[1] Winston A. Knight and Geoffrey Boothroyd, Fundamentals of Machining and Machine Tools, 3/e, Taylor & Francis Group, 2005.
[2] Trent, E. M. and P. K. Wright, Metal Cutting, 4th edition, Butterworth-Heinemann, 2000

E-resources and other digital material:

[1] https://openoregon.pressbooks.pub/manufacturingprocesses45/
[2] www.americanmachinist.com/
[3] http://www.machinetools.net.tw/

20ME7402 C
METAL FORMING

Course Category: Programme Elective
Course Type : Theory
Prerequisites: 20ME3302 -Mechanics of Materials

Credits: 3
Lecture/Tutorial/ Practice:3 /0/ 0
Continuous Evaluation: 30
Semester end Evaluation:70
Total Marks:100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO 1: understand fundamentals of metal forming.
CO 2: know various process parameters and applied loads in forging and sheet metal working
CO 3: analyze Rolling and Extrusion processes and associated parameters.
CO4: analyze Drawing and various High Energy Rate forming processes.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1	M	H	M											H
CO2	M	H	M											H
CO3	M	H	M											H
CO4	M	H	M											H

(L-Low, M-Medium, H-High)

UNIT – I

Fundamentals of Metal Forming: Concepts of true stress and true strain. Stress-strain relationship in plastic deformation. Yield criteria and their significance,Tresca& Von-Mises yield criteria. Formability limits. Classification of forming processes, Mechanisms of metal forming: slab method, Upper and lower bound analysis, deformation energy method, temperature of metal working, hot working, Warm working, cold working friction and lubricants., Strain rates in metal forming. Super plasticity. Development of metallurgical structure during deformation

UNIT – II

Forging: Classification of forging processes, forging of plate, forging of circular discs, open die and closed-die forging, forging defects, and powder metallurgy forging. Problems on flow stress, true strain and forging load.

Press tools: General classification and components of press tools. Types of dies like simple dies, compound dies combination dies and progressive dies. Blanking, punching, problems on Blanking and punching force, clearances, Elastic recovery and shear.

Sheet metal forming: Forming methods, bending, stretch forming, Spinning.

UNIT – III

Rolling: Rolling processes, forces and geometrical relationship in rolling, simplified analysis, rolling load, rolling variables, theories of cold and hot rolling, problems and defects in rolling, torque and power calculations, Problems.

Extrusion: Classification, Hot Extrusion, Analysis of Extrusion process, defects in extrusion, extrusion of tubes and production of seamless pipes. Problems on extrusion load.

UNIT – IV

Drawing: Drawing of tubes, rods, and wires: Wire drawing and tube drawing processes, analysis of wire, deep drawing and tube drawing .Problems on draw force.

Advanced Metal forming processes: Electromagnetic forming. Explosive Forming, Electrohydraulic forming.

Miscellaneous Forming Processes: Coining, Thread Rolling, Tube piercing,

Text Books:

1. Manufacturing Science- Amitabha Ghosh , Asok Kumar Mallik, EWP
2. Mechanical Metallurgy by G. E. Dieter, McGraw-Hill.
3. Fundamentals of Metal Forming Processes – B.L. Juneja

Reference Books:

1. Metal Forming: Fundamentals and Applications by Taylan Altan (ASM Series in Metal Processing)
2. Introduction to Industrial Mechanical Working Process by G. W. Rowe
3. Materials & Processes In Manufacturing By E.Paul De Germo, J T Black & Ronald A Koshav
4. Modern Control Engineering by Ogata, PHI Publ. Prentice-Hall of India Pvt. Ltd.
5. Manufacturing Technology (Foundry, Forming and Welding) by P. N. Rao, TMH.

20 ME7403 A
OPERATIONS RESEARCH

Course Category: Program elective **Credits: 3**
Course Type: Theory **Lecture/Tutorial/ Practice: 3 /0/ 0**
Prerequisites: - **Evaluation: 30**
Evaluation: 70
Total Marks: 100
Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Develop an LPP model and apply different methods for solving.

CO2: Determine optimal allocation of resources.

CO3: Apply Queuing theory model and Project scheduling techniques to real life problems

CO4: Evaluate the concept of game theory and develop optimal schedule.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO1	H	H			H									M
CO2	M	H			H									M
CO3	M	H			H									M
CO4	M	H			H									M

(L-Low, M-Medium, H-High)

UNIT – I:

Introduction: Definition and Scope of Operations Research, Limitations of Operations Research, Model Building in Operations Research.

Linear programming: Mathematical formulation of the problem, Graphical method, Simplex method, artificial basis technique, dual Simplex method. Degeneracy, alternative optima, unbounded solution, infeasible solution.

UNIT – II:

Transportation problem: Basic feasible solution by north-west corner method, Vogel's approximation method, assignment by inspection method. Finding optimal solution, degeneracy, unbalanced transportation matrix.

Assignment problem: One-to-one assignment problem, optimal solution, unbalanced assignment matrix

UNIT – III:

Queuing theory: Queuing systems and their characteristics. M/M/1 : FCFS/ μ / μ

Project planning through networks: Arrow (Network) Diagram representation. Rules for constructing an arrow diagram, PERT and CPM, Critical path calculations, earliest start and latest completion times, Determination of critical path, determination of floats, Probability considerations in project, cost considerations in project scheduling, crashing (least cost project scheduling).

UNIT – IV:

Game theory: Optimal solution of two-person zero-sum games, the max-min and min-max principle. Games without saddle points, mixed strategies.Arithmetic and algebraic methods, reduction by dominance and average, method of sub games, graphical method.

Sequencing: Introduction, Job shop Scheduling, Flow shop Scheduling, Solution of Sequencing Problem, Processing of n Jobs through two machines, Processing of n Jobs through m machines.

Text Books:

[1]S. D Sharma, 'Kedarnath, Ramnath& Co., Operations Research, Macmillian publishers Meerut.16th Edition, 2009.
[2] V. K Kapoor Operations Research,S.ChandPublications , 7 th edition, 2001.

Reference books:

[1] R Pannerselvam, Operations Research, Pentice Hall of India Pvt Ltd-New Delhi 2nd Edition.2006

E-resources and other digital material:

[1] http://en.wikipedia.org
[2] http://coral.ie.lehigh.edu
[3] http://books.google.co.in
[4] http://www.universalteacherpublications.com/univ/ebooks/or/Ch1/origin.htm
[5] http://www.wolfram.com/solutions/OperationsResearch/

20ME7403 B
MANUFACTURING MANAGEMENT

Course Category: Programme Elective **Credits**: 3
Course Type : Theory **Lecture/Tutorial/ Practice**: 3 /0/ 0
Prerequisites: **Continuous Evaluation**: 30
Semester end Evaluation:70
Total Marks:100

Course Outcomes:
Upon successful Completion of the course, the student will be able to:
CO1: Understand the different types production systems and various forecasting methods.
CO2: Develop a Master production schedule.
CO3: Apply an appropriate inventory model.
CO4: Identify the variations and causes in a production process.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	M										H			M
CO2	M										H			M
CO3	M										H			M
CO4	M										H			M

(L-Low, M-Medium, H-High)

UNIT - I
Production systems: Continuous and intermittent production. Mass and flow production, batch production, job order production, production functions. Production Planning & Control Functions**.**

Forecasting: Forecasting variables, forecasting procedure, and methods of forecasting: moving average, least squares, simple exponential smoothing, linear regression, correlation coefficient, problems.

UNIT - II
Aggregate planning and scheduling: Long range, intermediate range and short range plans, the aggregate planning problem, aggregate planning strategies**.**

Master scheduling: Master scheduling formation: inputs and outputs. Master scheduling methods.

UNIT – III
Materials Management and Inventory Control: Functions of materials management, purpose of inventories, types of inventories, relevant costs in inventory control, ABC, VED and XYZ analysis.

Economic order quantity (EOQ) models: Basic EOQ, economic production run length (ERL), quantity discounts, safety stock, problems, P & Q Systems of Control.

Materials requirement planning (MRP): Importance of MRP and CRP, MRP system inputs and outputs, bill of materials, MRP logic, MRPII, Just in Time Production Systems: Just-in-Time System: Evolution, Characteristics of JIT Systems, Continuous Improvement, The Kanban System, Calculation of number of Kanban's Requirements for implementation JIT – benefits of JIT.

UNIT – IV

Quality control: Tolerance limits of a process, control charts for variables: X and R charts. Control charts of attributes, p-chart, and c-chart.

Acceptance sampling: single sampling, double sampling and multi sampling plans for attributes, OC curves, Introduction to TQM, Deming's quality philosophy, Taguchi quality philosophy, introduction to e-Manufacturing.

Text Books:

[1] Joseph G. Monks "Operations Management" 3rd Edition TMH,1987.
[2] Marthand Telsang "*Industrial Engineering and Production management"* S.Chand Publications.

Reference books:

[1] Dale H. Besterfield "Quality Control" Prentice Hall 1995
[2] Gerhard Greeff, Ranjan Ghoshal Oxford, Burlington, MA : Newnes, " Practical E-Manufacturing and Supply Chain management" Copyright © 2004 Elsevier Ltd.
[3] Gopalakrishnan and Sudhakaresan "Materials Management"

E-resources and other digital material:

[1] www.transtutors.com
[2] www.prenhall.com

20ME7403/C
FLEXIBLE MANUFACTURING SYSTEMS & GROUP TECHNOLOGY

Course Category : Program Elective
Course Type : Theory
Prerequisites : -Nil-

Credits: 3
Lecture/Tutorial/Practice: 3/0/0
Continuous Evaluation: 30
Semester End Evaluation: 70
Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Familiarize with the concept of Automation, Flexible Manufacturing Systems, FMS architecture and its classifications.

CO2: Identify the different concepts of automated material handling and various automated storage systems.

CO3: Analyze the computer control systems of FMS and concepts of Group Technology.

CO4: Recognize the different types coding systems and applications of GT.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO 1	H				M		L							M
CO 2	H				M		L							M
CO 3	H				M		L							M
CO 4	H				M		L							M

(L-Low, M-Medium, H-High)

UNIT I

Introduction: Automation, Need of automation, Basic elements of an automated system, Types of automation, Manufacturing Automation, Components of manufacturing system, classification of manufacturing systems, Introduction to FMS system, Need, Concept of flexibility, Types of FMS, Architecture of FMS, Components of FMS, Work piece flow in FMS, FMS planning and implementation issues, FMS benefits and applications

UNIT II:

Automated material handling: Function of Material handling systems, Types of Material handling equipment, Conveyor systems, Automated Guided Vehicles (AGV), Industrial Robots.

Automated storage systems: Storage System Performance, Storage Location Strategies, Automated storage and Retrieval Systems, Characteristics of Storage Systems.

UNIT III:

Computer control system of FMS: Functions of Computer, Control system architecture, Continuous versus Discrete Control, Computer Process Control, Forms of Computer Process Control, Programmable Logic Controllers, Factory communications, Local area networks.

Group Technology: Introduction, Need, Part families, Methods for developing part families.

UNIT IV:

Basic type of codes: Codes and coding systems structures, Hierarchical codes, Poly code, Mixed code, Optiz classification and coding system, KK-3 system, the MICLASS system, Production flow analysis, Group Technology Machine Cells, Advantages and Limitations, Guidelines for implementing Group Technology, Applications of GT.

Text Books:

1. Automation, Production Systems and Computer Integrated Manufacturing by M.P.Groover, 3rd Edition 2007,Prentice Hall.
2. CAD/CAM/CIM by P.Radhakrishnan, S.Subramanyan & V.Raju, 2nd Edition 2002, New age international publishers.

Reference Books:

1. Performance Modeling of Automated Manufacturing Systems, N. Viswanadham, Y.Narahari.1992 , Prentice hall.
2. Computer Aided Design and Manufacturing by K. Lalit Narayan, 2008, PHI Pvt. Ltd.
3. CAD/CAM Handbook by Eric Teichloz.1985,TMH.
4. Computer Integrated Design and Manufacturing by Bedworth Henderson,1991, TMH.

E-resources and other digital material

[1] http://www.mechanicalindetail.info/advanced-manufacturing-systems/

[2] http://www.scribd.com/doc/19321303/Flexible-Manufacturing-SystemsFMS-A-Whitepaper.

20ME7404 A
COMPUTATIONAL FLUID DYNAMICS

Course Category: Programme Elective **Credits**: 3
Course Type : Theory **Lecture/Tutorial/ Practice**: 3 /0/ 0
Prerequisites: 20ME3303 Basic Thermodynamics **Continuous Evaluation**: 30
20BS4101 Fluid Mechanics **Semester end Evaluation**: 70
20ME6302 Heat Transfer **Total Marks:** 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: ***Identify*** the applications of CFD and ***build*** the governing equations of fluid flow

CO2: ***Classify*** the partial differential equations and ***develop*** finite differences for partial derivatives.

CO3: ***Formulate*** solution techniques for parabolic and hyperbolic equations

CO4: ***Analyze*** some of the popular FD techniques in the solution of fluid flow problem

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO 1	H		L		L								M	
CO 2	H		L		L								M	
CO 3	M	M	M		H								M	
CO 4	M	M	M		H								M	

(L-Low, M-Medium, H-High)

UNIT I:

Importance and applications of CFD, Models of flow, governing equations of fluid flow – Navier Stokes and Euler's equations: Continuity, Momentum and Energy equations in differential form, Physical boundary conditions.

UNIT – II:

Classification of partial differential equations, Discretization techniques- FDM, FEM, FVM, Finite Difference equations- Taylor series, order of accuracy, forward, backward and central differences for first order and second order differential equations.

UNIT – III:

Difference equations, Explicit and Implicit approaches, Thomas Algorithm (TDMA),

Analysis of stability, VN stability criteria for parabolic (1-D unsteady heat equation) and Hyperbolic (1st orderwave equation) equations, Courant number.

UNIT – IV:

Simple CFD techniques: Lax-Wendorff technique, McCormack's technique and Iterative and Relaxation techniques, Pressure correction technique, staggered grid, SIMPLE algorithm, Boundary conditions for pressure correction method.

Text books:

[1] Computational Fluid Dynamics - Basics with Applications - John. D. Anderson, JR. McGrawHill Education (India) Edition 2012.
[2] Computational Fluid Dynamics - T. J. Chung, Cambridge University Press, 2nd Edition, 2014.

Reference books:

[1] Introduction to computational fluid mechanics - Niyogi, Chakravarty, Laha, Pearson pub,1st Edition, 2009.
[2] Numerical heat transfer and fluid flow - S.V. Patankar, Hemisphere Pub., 1st Edition.
[3] Computational Fluid flow and Heat transfer - K. Muralidhar and T. Sundararajan-, Narosa Pub.2nd Edition, 2003.

E-resources and other digital material:

[1] http://ocw.mit.edu/courses/mecharlical-engineering/2-29-numerigal-fluid-mechanics-fall2011/
[2] http:/inptel.ac.in/courses/112105045/ (IIT Kharagpur)
[3] http://nptel.ac.in/courses/112107080/ (IIT Roorkee)
[4] http://nptel.ac.in/courses/112104030/ (IIT Kanpur)
[5] littp://www.nptelvideos.in/2012/11/computational-fluid-d)'namics.html (IIT Madras)
[6] http://www.cfd-onIine.com/

20ME7404 B
ENERGY RESOURCE UTILIZATION

Course Category: Program Elective
Credits: 3
Course Type: Theory
Lecture – Tutorial – Practice: 3 / 0 / 0
Prerequisites:
Continuous Evaluation: 30
20ME5301Applied Thermodynamics
Semester End Evaluation: 70
20ME5404 Internal Combustion Engines
Total Marks: 100

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO1: Acquire knowledge about steam and hydroelectric power plants
CO2: Acquire knowledge about diesel, gas and nuclear power plants
CO3: Distinguish the Energy conservation measures for different non-conventional energy resources and their utilization.
CO4: Acquire the knowledge of basic principles of energy auditing, types and objectives, instruments used

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO 1		M											M	
CO 2		M											M	
CO 3		M											M	
CO 4		M											M	

(L – Low, M – Medium, H - High)

Course Content:

UNIT - I

Hydrology & Hydroelectric power plant: Introduction, Hydrology-rainfall, runoff and their measurement, hydrograph, flow duration curve, mass curve and calculation of storage capacity, Hydro Electric power plant-Elements, Layout, Classification, advantages.

Steam power plant: Typical layout of steam power plant, site selection, coal handling, ash handling, draught, coal analysis, pulverized coal firing system, electrostatic precipitator, deaeration, cooling towers.

UNIT – II

Diesel and gas turbine power plants: General plant layouts, working of Diesel power plant, working of closed and open gas turbine plants, applications, advantages and disadvantages.

Nuclear power plants: Nuclear fission, chain reaction, types of reactors -Pressurized water reactor, boiling water reactor, liquid metal Fast Breeder reactor.

Unit – III

Solar energy: Solar thermal conversion, solar thermal power generation photo voltaic conversion

Wind energy: basic components of wind energy conversion systems, Classification of wecs, typesof wind machines.

Energy from Bio-gas: Classification of Bio-gas Plants, Factors affecting Bio-digestion orgeneration of Gas, Thermionic Generation and generation.

Geo-thermal energy: Geothermal sources, hydrothermal resources, Vapor dominated systems,liquid dominated systems.

Energy from ocean: Ocean thermal energy conversion systems, Open cycle OTEC system, Closed cycle OTEC system.

Direct energy conversion systems: principle operation of a fuel cell (with reference to H_2,O_2 cell), principle of MHD Power generation

UNIT – IV

Energy Management:

Power Plant Economics: Introduction, Load duration curves, Various performance factors (loadfactor, diversity factor, use factor etc.), operating costs, effect of load factor on cost per KWh.

Energy Auditing: Introduction, types of energy audit – audit instruments, energy conservation schemes – energy index – cost index – pie charts – sankey diagrams – load profiles

Text books:

1. Power Plant Engineering- P.K.Nag – Tata McGraw hill , 3rd Edition.
2. Non ConventionalEnergyResources - G.D.Rai -khanna publications 4th Edition
3. Energymanagement-W.R.MURPHY& G.MICKAY

Reference books:

1. Power Plant engineering- - ARORA,DOMAKUNDWAR,DHANPATRAI & CO 2010
2. Power Plant Technology - M.M. EL Wakil TMH, 1984
3. Principles of Energy Conversion - A.W.Culp, TMH,1979
4. Waste heat recovery systems-D.A.Reay-Pergmon press
5. Hand book of energy audits-Albert Thuann
6. Energy Management Conservation and Audits- Anil Kumar CRC Press

E-resources and other digital material

1. en.wikipedia.org/wiki/Thermal_power_station

20ME7404 C
AUTOMOBILE ENGINEERING

Course Category: Program Elective
Credits: 3
Course Type: Theory
Lecture – Tutorial – Practice: 3 / 0 / 0
Prerequisites:
Continuous Evaluation: 30
20ME5404 I.C. Engines & Gas Turbines
Semester End Evaluation: 70
Total Marks: 100

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO1: Identify the different engine components & maintenance procedures.
CO2: Illustrate different automobile cooling, lubrication and electrical systems.
CO3: Understand the working of automobile transmission system components.
CO4: Identify different automobile vehicle suspension and control systems.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO 1	M					M							L	
CO 2	M					M							L	
CO 3	M					M							L	
CO 4	M					M							L	

(L – Low, M – Medium, H - High)

Course Content:

UNIT - I

Introduction: Classification of automotive vehicles, applications, transmission arrangements.

Engine Components: Engine construction, combustion chambers for petrol and diesel engines, pistons, DTSI, valve arrangements and operating mechanisms, firing order, crankshaft, flywheel.

Engine Servicing and Maintenance: Engine trouble-shooting, engine testing procedures and instruments used, engine tests, reconditioning of engine components – valve seat boring, cylinder reboring, crankshaft grinding.

UNIT – II

Cooling systems for I. C. Engines: Need for cooling system, air cooling and water cooling - thermo-syphon and forced circulation, radiator, thermostat, antifreeze solutions.

Lubricating systems for I. C. Engines: Petroil, splash, pressure & dry sump lubrication systems, oil filters, crankcase ventilation.

Electrical system for I. C. Engines: Ignition systems – battery-, magneto- & electronic Ignition, spark plugs, alternator, cutout, current and voltage regulators, starting motors - Bendix drive mechanism, lighting, instruments and accessories.

UNIT – III

Transmission system: Introduction to chassis & transmission, Clutches – single plate, multi-plate, diaphragm and centrifugal clutches, clutch actuating mechanisms.

Gear boxes and others: Gear Box types - sliding mesh, constant mesh & synchromesh type, selector mechanism, automatic transmission, continuously variable transmission system, propeller shaft, differential.

UNIT – IV

Suspension systems: Need for suspension systems, springs, shock absorbers, axles – front and rear, different methods of floating rear axle, front axle and wheel alignment

Vehicle control: Steering mechanisms and power steering, types of brakes and brake actuation mechanisms (air and hydraulic), disc brakes, anti-lock braking system, air bags, types of wheels & tyres.

Text books:

[1] Automobile Engineering – Vol. I & II - Kirpal Singh, Standard Publishers.
[2] Automobile Engineering - R.B. Gupta, Satya Prakashan.

Reference books:

[1] Automobile Engineering - G.B.S. Narang, Khanna Publishers.
[2] Automotive Mechanics - Joseph Heitner, Van Nastrand Rehinhold.
[3] Automotive Mechanics – William H. Crouse, D.L. Anglin, Tata McGraw hill.

E-resources and other digital material

- www.gec.ac.in/~bsm/automobile/automobile.html
- http://auto.howstuffworks.com/engine2.htm
- www.carbibles.com/steering_bible.html
- www.educypedia.be/education/carjava.htm

20ME7205 A
ELECTRIC AND HYBRID VEHICLES

Course Category: Open Elective/Job Oriented Elective
Course Type : Theory

Credits: 3
Lecture/Tutorial/ Practice: 2 /0/ 2
Continuous Evaluation: 30
Semester end Evaluation:70
Total Marks:100

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1: Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electric vehicles.

CO2: Identify various sources for hybrid vehicles and their working.

CO3: Judge suitable hybrid vehicle as per the need based on the type of motor and configuration used

CO4: Identify power electronic converters involved and charging methods

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1		M											M	
CO2			M										M	
CO3					M								M	
CO4									M				M	

(L-Low, M-Medium, H-High)

UNIT - I: Introduction to hybrid vehicles

History of electric vehicle, history of hybrid electric vehicle, history of fuel cell vehicle, advantages and limitations, air pollution and global warming, Electric vehicle drive train: EV transmission configurations, transmission components, ideal gear box, types of hybrid electric vehicles

UNIT- II: Energy sources for hybrid vehicles

Battery: principle and types, Li-ion battery, ultra capacitor, fuel cells: operating principles of PAFC,PEM, MCFC,SOFC, DMFC,PCFC,ZAFC, Alkaline and Regenerative cells.

UNIT- III: Electric machines for hybrid vehicles

Permanent magnet synchronous motor, switched reluctance motor, induction motor, permanent magnet brushless DC motor, regenerative braking system.

UNIT-IV: Power electronics for hybrid vehicles: Introduction to digital and Analog Inputs,Basic switches: diode, power transistor, power MOSFET, inverters, charging of hybrid electric vehicle.

Suggested Books:

1. Iqbal Husain, ELECTRIC and HYBRID VEHICLES, Design Fundamentals, CRC Press, 2003.
2. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010.
3. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2015.

Reference Books:

1. Sandeep Dhameja, "Electric Vehicle Battery System
2. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles
https://swayam.gov.in/courses/-electric-vehicles

20ME7205 B
SOLAR ENERGY UTILIZATION

Course Category: Open Elective/ Job Oriented Elective
Course Type : Theory
Prerequisites : None

Credits: 3
Lecture/Tutorial/ Practice: 2 /0/2
Continuous Evaluation: 30
Semester end Evaluation:70
Total Marks:100

Course Outcomes:
Upon successful Completion of the course, the student will be able to:

CO1: Interpret the solar radiation data and its measurement
CO2: Understand the principles of solar energy collection and devices
CO3: Classify types of solar energy systems and their applications
CO4: Understand power generation using solar PV systems

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO2
CO1	M												L	
CO2	M		M										L	
CO3	M							M		M			L	
CO4	M		M					M		M			M	

(L-Low, M-Medium, H-High)

UNIT - I

Introduction:
Applications of Solar Energy, Solar energy utilization in India
Solar Radiation: Solar constant, Solar time, Solar angle, Radiation measurement and devices, Solar radiation data, estimation of average solar radiation on tilted and horizontal surfaces.

UNIT - II

Flat Plate Collector: Description, performance analysis of FPC, Collector efficiency, overall loss coefficient, heat removal factor. Effect of absorber coatings, dust, shading on the performance of collector, selection of materials for FPC.
Focusing Collectors: Types of concentrating collectors, Orientation and tracking systems, materials for concentrating collectors

UNIT – III

Thermal Energy Storage: Types, Sensible and Latent heat storage, Electrical, chemical and hydro storage of solar energy. Solar Pond- principle, description, extraction of thermal energy, types and application of solar ponds.

Other Applications: Solar water heating, natural and forced circulation heaters, series and parallel array, solar cooling systems, Solar thermal power generation, solar furnace

UNIT – IV

Solar Photo Voltaic: Solar cell principle, PV cell, efficiency, cell materials, Solar PV systems for power generation- stand alone, grid type and hybrid, solar cell modules, design of PV system, Applications of solar PV systems, advantages and disadvantages of solar PV system

Text Books:

1. Solar energy utilization - G.D. Rai, Khanna Publishers, 4th ed., 2009.
2. Solar energy - Sukhatme S.P., TMH., 3rd ed.,2008
3. Solar engineering of thermal processes - Duffie J.A. and Beckman W.A.,4th ed., 2001.

Reference books:

1. Non-conventional Energy resources - S.K. Dubey, S.K. Bhargava,Dhanpatrai publications, 1stEdition, 2009
2. Principles of solar engineering - D.Y. Goswami, F. Kreith and J.F.
3. Kerider, Taylor& Francis publishers,USA, 2nd edition, 2008
4. Fundamentals of solar energy conversion - Edward E.Anderson, 1st Ed.

E-resources and other digital material:

1. science.howstuffworks.com/...vs.../what-are-some-practical-uses-for-solar energy.htm
2. solarpowernotes.com/solar-energy-applications.html
3. www.seci.gov.in/
4. www.makeinindia.com/sector/renewable-energy
5. www.renewableenergyworld.com/solar-energy/tech.html
6. https://www.nrel.gov/workingwithus/re-solar.html

20ME7206 A
PROJECT MANAGEMENT

Course Category: Open Elective/ Job Oriented Elective
Course Type : Theory
Prerequisites : None

Credits: 3
Lecture/Tutorial/ Practice: 2 /0/2
Continuous Evaluation: 30
Semester end Evaluation:70
Total Marks:100

Course Outcomes:
Upon successful Completion of the course, the student will be able to:

CO1: Understand the significance of project management its objectives and various phases involved in project management life cycle.
CO2: Gain knowledge regarding project feasibility study and various Organizational issues.
CO3: Able to apply various tools like CPM & PERT in project management.
CO4: Gain knowledge in risk management and role of IT in project management.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1	M											H		H
CO2	M											H		H
CO3	M											H		H
CO4	M											H		H

(L-Low, M-Medium, H-High)

UNIT - I
Basics of Project Management: Introduction, Evolution of project management, Objectives of project management, Types of project, Types of project delays, Benfits of project Management, Stake holders of a project.

Project Management Life cycle: Phases of Project Management Life Cycle, Role of a Project Manager (PM).

UNIT - II
Project Feasibility study: Introduction, Pre-Feasibility Study, Types of feasibility, Steps of feasibility study.

Project Organizational Structures: Introduction, Concept of Organizational Structure, Essential qualities of a project manager, Organizational structure for projects, Project management offices.

UNIT – III

Techniques of Project Management: Introduction, Guidelines for network construction, Criticalpath method, Gantt chart, Project Evaluation and review technique.

Crashing of Project network: Introduction, General guidelines for network crashing, Types of crashing.

UNIT – IV

Project Risk Management and failure: Introduction, Types of Risk, Steps in Risk Management, Risk Assesment, Project failure-causes of project failure.

Project Management Information System: Introduction, Project Management Information System (PMIS), Planning of PMIS.

Text Books:

[1] P. Panneerselvam, R. Senthilkumar, "Project Management" PHI 2009.

[2] Ramakrishna & Kamaraju " Essentials of Project Management" Kindle Edition PHI, 2010

Reference books:

[1] Harold Kerzner "Project Management- A system approach to planning, scheduling & Controlling" Eleventh Edition, wiley.

[2] Thomas Erickson & P. V. Khatri " Project Management" Global Vision Publishing House (2015).

E-resources and other digital material:

[1] https://project-management.com/top-10-main-causes-of-project-failure/

[2] https://www.brighthubpm.com/project-planning/44058-the-project-management-information-system-pmis-described/

[3]https://www.usbr.gov/excellence/Finals/FinalIntroPM.pdf

[4] www.manage.gov.in/studymaterial/PM.pdf

20ME7206 B
STATISTICAL QUALITY CONTROL

Course Category: Programme Elective
Credits:3
Course Type: Theory
Lecture/Tutorial/Practice: 2/0/2
Prerequisites:
Continuous Evaluation:30
Manufacturing Management

Semester End Evaluation:70
Total Marks:100

Course Outcomes:
Upon successful Completion of the course, the student will be able to:

CO1: Understand the statistical parameters of the data
CO2: apply the control charts for variables to quality control
CO3: apply the control charts for attributes to quality control
CO4: Understand the importance of OC curve for defining the risks

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1											M	H		M
CO2											M	H		M
CO3											M	H		M
CO4											M	H		M

(L-Low, M-Medium, H-High)

Course Contents

UNIT I

Introduction: The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management (quality philosophy, links between quality and productivity, quality costs, legal aspects of quality implementing, quality improvement).

Modeling Process Quality: Mean, Median, Mode, Standard deviation, Calculating area, The Deming funnel experiment, Normal distribution tables, Finding the Z score, Central limit theorem.

UNIT II

Methods And Philosophy Of Statistical Process Control: Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of

control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length-ARL)

Control Charts For Variables: Control Charts for X-Bar and R- Charts, Type I and Type II errors, the probability of Type II error. Simple Numerical Problems

UNIT III

Process Capability: The foundation of process capability, Natural Tolerance limits, cp – process capability index, cpk, pp – process performance index, summary of process measures. Numerical problems

Control Charts For Attributes: Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, ControlCharts for Nonconformities or Defects, Control Chart for Number of non- conformities per unit. Numerical problems

UNIT IV

Lot-By-Lot Acceptance Sampling For Attributes: The acceptance sampling problem, single sampling plan for attributes, Double, Multiple, and Sequential sampling, AOQL, LTPD, OC curves, Military Standard 105E, the Dodge-Romig sampling plans. Numerical problems

Cumulative-Sum (Cusum) & Exponentially Weighted Moving Average (Ewma) Control Charts: CUSUM Control Chart (basic principles of the chart for monitoring the process mean); EWMA control chart (EWMA control chart for monitoring process mean), design of an EWMA control chart.

Text Books:

1. Statistical Quality Control, E.L.Grant and R.S.Leavenworth, 7th edition McGraw-Hill publisher.
2. Statistical Quality Control, RC Gupta, Khanna Publishers, New Delhi,2005

Reference Book:

1. Quantitative Techniques and management, N D Vohra, 4th edition Tata Mc Graw Hill 2019.

Web Resources:

1. https://study.com/academy/lesson/operating-characteristic-oc-curve-definition-uses.html.
2. https://www.businessmanagementideas.com/production-2/control-charts-for-variables-and-attributes-quality-control/7044

20ME7607
COMPUTATIONAL FLUID DYNAMICS LAB

Course Category: Advanced Skill Course **Credits**: 2
Course Type : Laboratory course **Lecture/Tutorial/ Practice**: 1 /0/ 2
Prerequisites: 20ME3303 Basic Thermodynamics **Continuous Evaluation**: 30
20BS4101 Fluid Mechanics **Semester end Evaluation**: 70
20ME6302 Heat Transfer **Total Marks:** 100

Course Outcomes:
Upon successful Completion of the course, the student will be able to:
CO1: Simulate the fluid flow concepts using CFD software.
CO2: Apply the convergence techniques to refine the solution
CO3: Interpret the results to arrive reasonable conclusions
CO4: Document the results generated in a systematic manner.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO 1	H	L										M	H	
CO 2	M	M		H	H								L	
CO 3	L	H		H	H					L		H	M	
CO 4				H	H					H				

(L-Low, M-Medium, H-High)

Experiments:

1. Numerical methods in fluid mechanics and use of CFD software.
2. Couette flow and Channel flow
3. Flow over a flat plate (Hydrodynamic and Thermal boundary layers)
4. Flow through circular and Non-circular pipes
5. Flow over an aerofoil
6. Flow over Cylinder and Sphere
7. Analysis of double pipe heat exchangers
8. Phase change simulation
9. Compressible flow through nozzles
10. Coupling of fluid – thermal – structural analysis

Text books:

[1] Computational Fluid Dynamics - Basics with Applications - John. D. Anderson, JR. McGraw Hill Education (India) Edition 2012.

[2] Computational Fluid Dynamics - T. J. Chung, Cambridge University Press, 2nd Edition, 2014.

Reference books:

[1] Introduction to computational fluid mechanics - Niyogi, Chakravarty, Laha, Pearson pub, 1st Edition, 2009.

[2] Numerical heat transfer and fluid flow - S.V. Patankar, Hemisphere Pub., 1st Edition.

[3] Computational Fluid flow and Heat transfer - K. Muralidhar and T. Sundararajan-, Narosa Pub. 2nd Edition, 2003.

E-resources and other digital material:

[1] https://www.ansys.com/en-in/products/fluids/ansys-fluent

[2] https://courses.ansys.com/index.php/fluids/

[3] https://confluence.cornell.edu/display/SIMULATION/FLUENT+Learning+Modules

[4] https://forum.ansys.com/discussion/1493/ansys-fluent-tutorials

[5] https://cfd.ninja/ansys-tutorials/ansys-fluent-tutorials/

[6] http://users.abo.fi/rzevenho/ansys%20fluent%2018%20tutorial%20guide.pdf

20ME7551
MINI PROJECT - II

Course Category: Project
Course Type: Practical
Prerequisites:

Credits: 1.5
Lecture - Tutorial - Practice: 0/0/3
Continuous Evaluation: 30
Semester end Evaluation: 70
Total Marks: 100

Course Outcomes: At the end of the course the students will be able to

CO1: Identify the problem, define objectives and scope of the project work.
CO2: Carryout Team work.
CO3: Prepare and present a comprehensive report of the project work.
CO4: Apply the principles of Thermal Engineering to solve problems.
CO5: Solve Engineering problems using the concept of design and manufacturing.

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSOII
CO1									H					
CO2				H										
CO3							H	M						
CO4	M	M			H			M			M		H	
CO5	M	M			H			M			M			H

20ME7552
INDUSTRIAL / RESEARCH INTERNSHIP

Course Category : Institutional core
Course Type : Practical
Prerequisites:

Credits: 1.5
Lecture/Tutorial/Practice: 0/0/3
Continuous Evaluation: 30
Semester End Evaluation: 70
Total Marks: 100

CO1: Identify the problem, define objectives and scope of the project work

CO2: Carryout Team work

CO3: Prepare and present a comprehensive report of the project work

CO4: Apply the principles of Thermal Engineering to solve problems

CO5: Solve Engineering problems using the concept of design and manufacturing

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSOII
CO1												H		
CO2									H					
CO3								M		H				
CO4	M	H		M	M			M					H	
CO5	M	H		M	M			M						H

EIGHTH SEMESTER

20ME8551
MAJOR PROJECT AND INTERNSHIP

Course Category: Project **Credits:** 12

Course Type: Practical **Lecture - Tutorial - Practice:** 0/0/24

Prerequisites: **Continuous Evaluation:** **Semester end Evaluation:** 30 70

Total Marks: 100

Course Outcomes: At the end of the course the students will be able to

CO1: Identify the problem, define objectives and scope of the project work.

CO2: Carryout Team work.

CO3: Prepare and present a comprehensive report of the project work.

CO4: Apply the principles of Thermal Engineering to solve problems.

CO5: Solve Engineering problems using the concept of design and manufacturing.

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSOII
CO1									H					
CO2				H										
CO3							H	M						
CO4	M	M			H			M			M		H	
CO5	M	M			H			M			M			H