ROYAL GLOBAL UNIVERSITY
GUWAHATI

ROYAL SCHOOL OF ENGINEERING & TECHNOLOGY

(RSET)

Department of Mechanical Engineering

COURSE STRUCTURE
&
SYLLABUS

BACHELOR OF TECHNOLOGY
in
MECHANICAL ENGINEERING

VISION, MISSION, AND OBJECTIVES OF DEPARTMENT

VISION

To evolve into a centre of excellence by imparting professional education in mechanical engineering with a unique academic and research ambience that promotes inquisitiveness, creativity, innovation and excellence.

MISSION

1. To have state-of-the-art infrastructure facilities.
2. To have highly qualified and experienced faculty from academics, research organizations and industry.
3. To develop students as socially committed professionals with sound engineering knowledge, creative minds, leadership qualities and practical skills.
4. Conduct basic and applied research, provide consultancy services and cultivate the spirit of entrepreneurship.
5. Develop the habit of continuous learning, team work and fulfill the societal needs.

OBJECTIVES

1. Achieve excellence in learning and research through continual improvement in both content and delivery of the academic programmes.
2. Promote close interaction among industry, faculty and students to enrich the learning process and enhance career opportunities for students.
3. Develop state - of - the - art laboratories and other infrastructure commensurate with the need of delivering quality education and research services.
4. Strengthen the Institution through network of alumni and optimize use of resources by leveraging inter - departmental capabilities.
5. Provide opportunities and ensure regular skill. Upgradation of faculty and staff through structured training programmes.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Programme Educational Objectives (PEO) of the under-graduate programme Bachelor of Technology (B.Tech.) in Mechanical Engineering offered by The Assam Royal Global University, Guwahati-35, Assam are:

No.	PEO
PEO1	To provide a quality undergraduate education for students entering the mechanical engineering profession or seeking careers in related fields.
PEO2	To advance scientific knowledge through basic and applied research.
PEO3	To disseminate technical information through scholarly publication, conferences and continuing education.
PEO4	To enable to acquire knowledge of relevant technologies and multidisciplinary fields including broad social, ethical and environmental issues within which the engineering is practiced.
PEO5	To develop problem solving approach using analytical abilities, effective communication skills and team work.
PEO6	To create awareness and understanding related to societal issues, apart from developing a sense of commitment to the community and profession with sincere involvement.

PROGRAMME OUTCOMES (POs)

On successful completion of the under-graduate programme, i.e. B.Tech. in Mechanical Engineering, the Mechanical Engineering graduates will be able to,

No.	PEO
PO1	Apply knowledge of mathematics, science and engineering to arrive at solutions.
PO2	Identify, formulate and analyze engineering problems through technical literature.
PO3	Design a component, a process and a system to meet desired needs considering economic, environmental, social, ethical, health and safety, manufacturability and sustainability.
PO4	Conduct experiment, analyze and interpret data to arrive valid conclusions.
PO5	Use the techniques, skills, and modern engineering tools for modeling and prediction of problems by understanding the limitations.
PO6	Recognize the importance of health and safety, societal, cultural responsibility in the design and implementation of engineering projects.
PO7	Know and apply societal and environmental context to engineering solutions for sustainable development.
PO8	Apply the standards and professional ethics in engineering practice.
PO9	Function effectively as a member or leader of a team.
PO10	Express effectively, comprehend and write reports on the engineering activities.
PO11	Apply engineering and management principles to manage projects in multidisciplinary environments.

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B.TECH. IN MECHANICAL ENGINEERING
COURSE STRUCTURE

1st semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MEE022C101	Elements of Mechanical Engineering	3	1	0	4	4
2	MAT022C102	Mathematics - I	3	1	0	4	4
3	CEE022C117	Engineering Graphics & Design	1	0	4	3	5
4	MEE022C118	Workshop Practices	1	0	4	3	5
5	EVS982A103	Environmental Sciences - I	1	0	0	1	1
6	CEN982A101	Developing Oral Communication and	1	0	0	1	1
7	BHS982A104	Concepts of Behavioural Science	1	0	0	1	1
		TOTAL	**11**	**2**	**8**	**17**	**21**

2nd semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	PHY022C201	Physics	3	0	0	3	3
2	MAT022C202	Mathematics - II	3	1	0	4	4
3	ELE022C203	Basic Electrical Engineering	3	0	0	3	3
4	CSE022C204	Programming for Problem Solving	3	0	0	3	3
5	PHY022C211	Physics Lab	0	0	2	1	2
6	ELE022C213	Basic Electrical Engineering Lab	0	0	2	1	2
7	CSE022C214	Programming for Problem Solving Lab	0	0	2	1	2
8	EVS982A203	Environmental Sciences - II	1	0	0	1	1
9	CEN982A201	Conversation and Public Speaking	1	0	0	1	1
10	BHS982A204	Understanding Self and Others	1	0	0	1	1
		TOTAL	**15**	**1**	**6**	**19**	**22**

3rd semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MAT022C301	Mathematics III	3	1	0	4	4
2	ECE022C306	Basic Electronics Engineering	3	0	0	3	3
3	MEE022C303	Engineering Mechanics	3	1	0	4	4
4	MEE022C304	Primary Manufacturing	3	0	0	3	3
5	MEE022C305	Basic Thermodynamics	3	1	0	4	4
6	BIO022G301	Biology for Engineers	2	0	0	2	2
7	MEE022C314	Primary Manufacturing Lab	0	0	2	1	2
8	MEE022C319	Machine Drawing Lab	0	0	4	2	3
9	CEN982A301	Career Oriented Communication	1	0	0	1	1
		TOTAL	**18**	**3**	**6**	**24**	**26**

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B.TECH. IN MECHANICAL ENGINEERING
COURSE STRUCTURE

4th semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MEE022C401	Applied Thermodynamics	3	1	0	4	4
2	MEE022C402	Mechanics of Materials	3	1	0	4	4
3	MEE022C403	Kinematics & Theory of Machines	3	1	0	4	4
4	MEE022C404	Fluid Mechanics	3	1	0	4	4
5	ELE022C405	Electro-Technology	3	0	0	3	3
6	BSA022A401	Principles of Management & Organisational Behaviour	3	0	0	3	3
7	MEE022C414	Fluid Mechanics Lab	0	0	2	1	2
8	ELE022C415	Electro-Technology Lab	0	0	2	1	2
9	CEN982A401	Communication and Presentation skills	1	0	0	1	1
		TOTAL	**19**	**4**	**4**	**25**	**27**

5th semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MEE022C501	Design of Machine Elements	3	1	0	4	4
2	MEE022C502	Material Science	3	0	0	3	3
3	MEE022C503	Heat Transfer	3	1	0	4	4
4	MEE022C504	Power Plant Engineering	3	0	0	3	3
5	MEE022C512	Material Testing Lab	0	0	2	1	2
6	MEE022C513	Heat Transfer Lab	0	0	2	1	2
7	CEN982A501	Ethics and Business Communication	1	0	0	1	1
8	ILD992A503	Constitution of India	1	0	0	1	1
9	xxxxxxG5xxx	Open Elective I (from other schools)	3	0	0	3	3
		TOTAL	**17**	**2**	**4**	**21**	**23**

6th semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MEE022C601	Dynamics of Machines	3	1	0	4	4
2	MEE022C602	Internal Combustion Engines	3	0	0	3	3
3	MEE022D603X	Elective I (Departmental)	3	0	0	3	3
4	MEE022D604X	Elective II (Departmental)	3	0	0	3	3
5	COM022A606	Economics and Accountancy	3	0	0	3	3
6	MEE022C611	Dynamics of Machines Lab	0	0	2	1	2
7	CEN982A601	Effective Workspace Communication	1	0	0	1	1
8	ILD992S603	Essence of Indian Traditional Knowledge	1	0	0	1	1
9	xxxxxxG6xxx	Open Elective II (from other schools)	3	0	0	3	3
		TOTAL	**20**	**1**	**2**	**22**	**23**

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B.TECH. IN MECHANICAL ENGINEERING
COURSE STRUCTURE

7th semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MEE022C701	Finite Element Method	3	1	0	4	4
2	MEE022C702	Manufacturing Methods	3	0	0	3	3
3	MEE022D703X	Elective III (Departmental)	3	0	0	3	3
4	MEE022D704X	Elective IV (Departmental)	3	0	0	3	3
5	xxx02xG7xxx	Open Elective III (from within School)	3	0	0	3	3
6	MEE022C726	Project I	0	0	12	4	12
7	MEE022C74	Assessment of the Summer Training	0	0	0	2	0
		TOTAL	**15**	**1**	**12**	**22**	**24**

8th semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MEE022C801	Refrigeration and Air Conditioning	3	0	0	3	3
2	MEE022D802X	Elective V (Departmental)	3	0	0	3	3
3	MEE022D803X	Elective VI (Departmental)	3	0	0	3	3
4	xxxxxxG8xxx	Open Elective IV (from within the school)	3	0	0	3	3
5	MEE022C826	Project - II	0	0	10	5	10
6	MEE022C837	Comprehensive Viva	0	0	0	2	0
		TOTAL	**12**	**0**	**10**	**19**	**22**

Summary	**L**	**T**	**P**	**C**	**TCP**
SEM 1	11	1	10	17	22
SEM 2	15	1	6	19	22
SEM 3	18	3	6	24	26
SEM 4	19	4	4	25	27
SEM 5	17	2	4	21	23
SEM 6	20	1	2	22	23
SEM 7	15	1	12	22	24
SEM 8	12	0	10	19	22
Grand Total	**127**	**13**	**54**	**169**	**189**

Courses	**C**
Basic Science	22
Engineering Science	24
Humanities	12
Professional Core	63
Professional Elective	18
Open Elective	12
Project/Internship etc	13
Mandatory	6
Total	**169**

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ELECTIVES

MEE022D603X	**Elective I**	**L**	**T**	**P**	**C**
MEE022D6031	Gas Dynamics and Jet Propulsion	3	0	0	3
MEE022D6032	Instrumentation & Control	3	0	0	3

MEE022D604X	**Elective II**	**L**	**T**	**P**	**C**
MEE022D6041	Fluid Machines	3	0	0	3
MEE022D6042	Mechatronic Systems	3	0	0	3

MEE022D703X	**Elective III**	**L**	**T**	**P**	**C**
MEE022D7031	Project & Production Management	3	0	0	3
MEE022D7032	Total Quality Management	3	0	0	3

MEE022D704X	**Elective IV**	**L**	**T**	**P**	**C**
MEE022D7041	Automobile Engineering	3	0	0	3
MEE022D7042	Design of Transmission Systems	3	0	0	3

MEE022D802X	**Elective V**	**L**	**T**	**P**	**C**
MEE022D8021	Computational Fluid Dynamics & Heat Transfer	3	0	0	3
MEE022D8022	Fluid Power Control	3	0	0	3

MEE022D803X	**Elective VI**	**L**	**T**	**P**	**C**
MEE022D8031	Energy Conservation & Management	3	0	0	3
MEE022D8032	Metrology & Instrumentation	3	0	0	3

MEE022G509X	**Open Elective I (for other schools)**	**L**	**T**	**P**	**C**
MEE022G5091	Renewable Energy	3	0	0	3
MEE022G5092	Pollution Control Engineering	3	0	0	3

MEE022G609X	**Open Elective II (for other schools)**	**L**	**T**	**P**	**C**
MEE022G6091	Fundamentals of Automobile Engineering	3	0	0	3
MEE022G6092	3D Modelling & Printing	2	0	2	3

MEE022G705X	**Open Elective III (Within School)**	**L**	**T**	**P**	**C**
MEE022G7051	Operation Research	3	0	0	3
MEE022G7052	Composite Materials	3	0	0	3

MEE022G804X	**Open Elective IV (Within School)**	**L**	**T**	**P**	**C**
MEE022G8041	Process Planning & Cost Estimation	3	0	0	3
MEE022G8042	Problem solving using MATLAB & Simulink	3	0	0	3

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1	MEE022C101	Elements of Mechanical Engineering	3	1	0	4	4
2	MAT022C102	Mathematics - I	3	1	0	4	4
3	CEE022C117	Engineering Graphics & Design	1	0	4	3	5
4	MEE022C118	Workshop Practices	1	0	4	3	5
5	EVS982A103	Environmental Sciences - I	1	0	0	1	1
6	CEN982A101	Developing Oral Communication and Listening Skills	1	0	0	1	1
7	BHS982A104	Concepts of Behavioural Science	1	0	0	1	1
		TOTAL	**11**	**2**	**8**	**17**	**21**

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: I**
Paper I / Subject Name: Elements of Mechanical Engineering		**Subject Code: MEE022C101**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are: - • Learn the fundamental concepts of energy, its sources and conversion. • Comprehend the basic concepts of thermodynamics. • Understand the concepts of boilers, turbines, pumps, internal combustion engines and refrigeration. • Distinguish different metal joining techniques	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On completion of this course the students will be expected to: • Identify different sources of energy and their conversion process. • Explain the working principle of hydraulic turbines, pumps, IC engines and Refrigeration. • Recognize various metal joining processes and power transmission elements. • Understand the properties of common engineering materials and their applications in engineering industry.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

MODULE	CONTENTS OF THE SUBJECT	HOURS
I	**Sources of Energy:** Introduction and application of energy sources like fossil fuels, hydel, solar, wind, nuclear fuels and biofuels; environmental issues like global warming and ozone depletion. **Basic concepts of Thermodynamics:** Introduction, states, concept of work, heat, temperature; Zeroth, 1st, 2nd and 3rd laws of thermodynamics. Concept of internal energy, enthalpy and entropy (simple numericals). **Steam:** Formation of steam and thermodynamic properties of steam (simple numericals).	**10**

II	**Boilers:** Introduction to boilers, classification, Lancashire boiler, Babcock and Wilcox boiler. Introduction to boiler mountings and accessories (no sketches). **Turbines:** Hydraulic Turbines – Classification and specification, Principles and operation of Pelton wheel turbine, Francis turbine and Kaplan turbine (elementary treatment only). **Hydraulic Pumps:** Introduction, classification and specification of pumps, reciprocating pump and centrifugal pump, concept of cavitation and priming.	**10**
III	**Internal Combustion Engines:** Classification, I.C. Engines parts, 2 and 4 stroke petrol and 4-stroke diesel engines. P-V diagrams of Otto and Diesel cycles. Simple problems on indicated power, brake power, indicated thermal efficiency, brake thermal efficiency, mechanical efficiency, and specific fuel consumption. **Refrigeration and Air conditioning**: Refrigeration - Definitions - Refrigerating effect, Ton of Refrigeration, Ice making capacity, COP, relative COP, Unit of Refrigeration. Refrigerants, Properties of refrigerants, List of commonly used refrigerants. Principle and working of vapor compression refrigeration. Domestic refrigerator. Principles and applications of air conditioners, window, and split air conditioners**.**	**10**
IV	**Engineering materials:** Metals – Ferrous: cast iron, tool steels and stainless steels and nonferrous: aluminum, brass, bronze. Polymers - Thermoplastics and thermosetting polymers. Ceramics - Glass, optical fiber glass. Composites - Fiber reinforced composites, Metal Matrix Composites Smart materials – Piezoelectric materials, shape memory alloys, semiconductors, and insulators. **Joining Processes:** Soldering, Brazing and Welding Definitions. Classification and methods of soldering, brazing, and welding. Brief description of arc welding, oxy-acetylene welding, TIG welding, and MIG welding. **Belt drives Open & crossed belt drives,** Definitions -slip, creep, velocity ratio, derivations for length of belt in open and crossed belt drive, ratio of tension in flat belt drives, advantages and disadvantages of V belts and timing belts, simple numerical problems. **Gear drive** Types–spur, helical, bevel, worm and rack and pinion. Velocity ratio, advantages and disadvantages over belt drives, simple numerical problems on velocity ratio	**10**
	TOTAL	**40**

Text Books

1. B.Y. Patil H.G. Patil, *Elements of Mechanical Engineering*; January 2020; Dreamtech Press
2. K R Gopala Krishna, Sudheer Gopala Krishna, S C Sharma., *Textbook of Elements of Mechanical Engineering*, January 2015; Subhas Publications, Bangalore
3. S. Trymbaka Murthy., *Elements of Mechanical Engineering*, 3rd Edition, December 2013; I K International Publishing House Pvt. Ltd

Reference Books:

1. R.K. Rajput, *Elements of Mechanical Engineering*, Firewall Media, 2005.
2. Dr. A. S. Ravindra, *Elements of Mechanical Engineering*, Best Publications, 7th edition, 2009.
3. B.K. Agrawal, *Introduction to Engineering Materials*", Tata McGraHill Publication, New Delhi
4. Dr. D.S. Kumar, *Thermal Science and Engineering*", S.K. Kataria & sons Publication, New Delhi

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: I**
Paper II / Subject Name: Mathematics - I		**Subject Code: MAT022C102**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To enable students learn the fundamental concepts of single and multivariable differential calculus. • To make students understand different aspects of single and multivariable integral calculus. • To enable students develop the ability to apply differential and Integral calculus in real world problem.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On completion of this course the students will be expected to: • Apply the single and multivariable differential and Integral calculus in engineering problems. • Familiarize with the applications of differential and integral calculus in different fields of Engineering. • Solve system of linear equations. • Find basis and dimension of vector spaces and their applications	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Prerequisites: Concepts of Mathematics of +2 level

Detailed Syllabus:

MODULES	TOPICS / COURSE CONTENTS	HOURS
I.	**SINGLE VARIABLE CALCULUS:** Rolle's theorem, Mean value theorem (only statement and problem), Successive Differentiation , Leibnitz theorem, Taylor's and Maclaurin's Series, expansion of function. Jacobians and their applications (for two and three variables), Errors and Approximations. Reduction formula, concept of curve tracing. some important curves, area under Plane curves , volume and surface area of solids of revolution of plane curves.	**12**
II.	**MULTI VARIABLE CALCULUS:** Partial Derivatives, Euler's theorem on homogeneous function (statement & Application), Total derivatives. Differentiation under integral sign (Leibniz's rule), multiple integrals	**12**
III.	**APPLICATION OF CALCULUS** Maxima and Minima of Functions of two and three variables, Lagrange's method of undetermined multipliers. Area and Volume by double and triple integrals, Beta and Gamma functions.	**12**
IV	**LINEAR ALGEBRA:** Definitions and properties of (symmetric, skew-symmetric, Hermitian, skew-Hermitian, idempotent, nilpotent, involuntary, orthogonal, unitary). Computation of inverse by elementary transformations, reduction of matrices to Echelon form and normal form; rank of a matrix ; Consistency of a system of linear equations; solution of a system of linear equations (Cramer's rule, Gauss elimination method). Eigen values and Eigen vectors and their properties, Cayley-Hamilton theorem, Reduction of a matrix to diagonal form, diagonalization.	**12**
TOTAL		**48**

Text Books:

1. Bali N. P. and Narayan Iyenger N., *A text book of Engineering Mathematics*, Ninth edition, 2016, Laxmi Publication.

Reference Books:

1. Grewal B. S., *Higher Engineering Mathematics*, 43rd edition 2014, Khanna Publishers.
2. Das B. C. & Mukherjee B. N., *Differential Calculus*, 55th edition 1949, U. N. Dhur & Sons Pvt. Ltd.
3. Das B. C. & Mukherjee B. N, *Integral Calculus*, 57th edition 1983, U. N. Dhur & Sons Pvt. Ltd

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: I**
Paper III / Subject Name: Engineering Graphics & Design		**Subject Code: CEE022C117**
L-T-P-C – 1-0-4-3	**Credit Units: 03**	**Scheme of Evaluation: TP**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To make students understand about defining and specifying the shape and size of a particular object by means of lines and other information about the object. • To teach basic engineering drawing formats. • To make students learn drawing projections and sections. • To explain how to convert sketches to engineered drawings	1. Lecture 2. Demonstration 3. Lab Experiment 4. Assignment 5. Quiz 6. Viva-Voce	On completion of this course the students will be expected to: • read drawing which is the most important requirement of all technical people in engineering profession. • visualize the job in three dimensions. • Have clear conception and appreciation of the shape, size, proportion and design. • clearly express the ideas on the paper by sketches. • convert sketches to engineered drawings will increase.	• Continuous Evaluation: 25% (Skill Test, lab copy, viva, lab involvement: Any Three) • Attendance: 5% • End term examination: 70 %

Detailed Syllabus

Module	Content/Tutorial	Hours
I	Handling and uses of the drawing instruments. Single stroke letters, General rules of dimensioning.	6
II	Reducing and increasing scales, representative fraction, types of scales-plain, diagonal, Comparative, Vernier and Scale of chords. General method of construction of conics (Ellipse, Parabola and Hyperbola), tangent and normal on conics. Construction of ellipse by Arcs of Circle Method (tangent and normal on it) and Concentric Circle method. Cycloidal curves-Cycloid including tangent and normal on it, Trochoid, Epicycloid and Hypocycloid and tangent and normal on these curves, Archimedean Spiral and tangent and normal on it.	12

III	Introduction, Planes of Projection, Four Quadrants, First-Angle projection, Third-Angle projection (Introduction only). I. **Projection of points:** In different quadrants. II. **Projections of lines:** Inclined one plane and parallel to other. Inclined to both planes, true length of a line and its inclination to reference plane, traces of a line. III. **Projection of a plane:** Traces of a plane, projection of planes parallel to one of the reference planes, projection of planes inclinedto one reference plane and perpendicular to the other, Projection of oblique planes: square, rectangle, hexagon and set square. IV. **Projection of solids:** Simple solids in different positions, axis perpendicular to a plane axis parallel to both planes, axis parallel to one plane and inclined to the other, axis inclined to both planes, axis or edges makes given angles the face of a solid makes given angles	12
IV	Isometric axes and scales, isometric projection of plane figures, cube, prism, pyramids, cylinder, cone, sphere	6
		36

Text Books:

1. *Engineering Drawing;* Bhatt, N.D, 53rd Edition, 2016, Charotar Publishing House

Reference Books:

1. Jolhe Dhananjay A; *Engineering drawing*, 5th Edition, 2010,Tata McGraw-Hill Education Pvt. Ltd., New Delhi

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: I**
Paper IV / Subject Name: Workshop Practices		**Subject Code: MEE022C118**
L-T-P-C – 1-0-4-3	**Credit Units: 03**	**Scheme of Evaluation: TP**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • to acquaint students to work shops and tools	1. Lecture 2. Demonstration 3. Lab Experiment 4. Assignment 5. Quiz 6. Viva-Voce	On completion of this course the students will be expected to: • gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials • Handle Components with their own hands. • get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes. • to produce small devices of their interest by assembling different components.	• Continuous Evaluation: 25% (Skill Test, lab copy, viva, lab involvement: Any Three) • Attendance: 5% • End term examination: 70 %

(i) Lectures & videos (L-T-P-C: 1-0-0-1): (10 hours)

S. No.	Detailed Contents	Lectures
1	Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods	2
2	Welding (arc welding & gas welding), brazing	2
3	Fitting operations & power tools	2
4	Carpentry	2
5	Civil – Plumbing	2

(ii) Workshop Practice (L-T-P-C: 0-0-4-2): (40 hours)

S. No.	Detailed Contents	Hours
1	Machine shop	8
2	Fitting shop	8
3	Carpentry	8

4	Welding shop	8
5	Plumbing Shop	8

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: I**
Paper VI / Subject Name: Environmental Sciences - I		**Subject Code: EVS982A103**
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To create awareness about the importance of environment • To teach the students about the effect of technology on the environment and ecological balance	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On completion of this course the students will be expected to: • Know the importance of environmental studies and methods of conservation of natural resources. • Explain the causes, effects and control measures of various types of pollution • Recall social issues and legal provision.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Environment, Levels of organizations in environment, Structure and functions in an ecosystem.	**3**
II	Biosphere, its Origin and distribution on land, in water and in air, Broad nature of chemical composition of plants and animals	**3**
II.	Renewable and Non-renewable Resources, Forests, water, minerals, Food and land (with example of one case study); Energy, Growing energy needs, energy sources (conventional and alternative)	**3**
III.	Biodiversity at global, national and local levels; India as a mega-diversity nation; Threats to biodiversity (biotic, abiotic stresses), and strategies for conservation	**3**
	Total	**12**

Text Book:

1. Kaushik, A., Kaushik, C.P., *Perspectives in Environmental Studies*; 4th Edition, 2014, New Age International (P) Ltd. Publishers, New Delhi – 110 002.

Reference Books:

1. Sinha, J., *Environmental Science*, 1st Edition, 2011, Galgotia Publication Pvt Ltd, Darya Ganj, Delhi 110002.
2. Agarwal, R.K., *Environment & Ecology*, 1st Edition, 2008, Krishna Prakashan Media (P) Ltd, Meerut, India.
3. Miller, T.G., Spoolman, S., *Environmental Science*, 15th Edition, 2014, Cengage Learning, 20 Channel Street, Boston, MA 02210, USA.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: I**
Paper VII / Subject Name: Developing Oral Communication and Listening Skills		
		Subject Code: CEN982A101
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • to develop and enhance the students' oral communication skills in English by engaging them to meaningful discussion and interactive activities.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On completion of this course the students will be expected to: • Develop and enhance their oral communication skills in English.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Course content/ Topics	Periods
I	**Basics of Communication- Introduction** Communication - definition – meaning – elements - basics of communication - communication process - importance of communication Components of Communication Types/forms of Communication (Oral-written, Formal-Informal(Grapevine), Interpersonal-Intrapersonal, Mass- Group, Verbal-Non Verbal External communication, Organizational Communication- Upward, Downward, horizontal, Diagonal) Non-verbal Communication - Introduction; Body language- Personal Appearance, Postures, Gestures, Eye Contact, Facial expressions Paralinguistic Features-Rate, Pause, Volume, Pitch/Intonation/ Voice/ modulation Proxemics , Haptics, Artifactics, Chronemics	**4**
II	**The Listening Process** Types of Listening – Superficial, Appreciative, Focused, Evaluative, Attentive, Emphatic Listening with a Purpose Barriers to Communication, Barriers to Listening	**4**
III	**Focusing on Oral Group Communication** Nature of group communication Characteristics of successful Group Communication Selection of group discussion-subject knowledge, leadership skills, team management Group Discussion Strategies	**4**
IV	**Language Styles- Oral and Written Communication** Technical Style ABC of technical communication- accuracy, using exact words and phrases, brevity, clarity. Objectivity of Technical Writing Impersonal language, Objectivity in professional speaking. Formal language, Practice	**4**

Text Book:

1. Rizvi, Ashraf, M, *Effective Technical Communication*;;, 11th Edition; 2008; Tata McGraw-Hill Publishing Company Ltd, New Delhi 110 008.

Reference Book:

1. Kumar, V., Raj, B.; *Communicative and Functional English*; 1st Edition; 2013; Kalyani Publishers, New Delhi.
2. Koneru, A; *Professional Communication*; 2nd Edition; 2008; Tata McGraw-Hill Publishing Company Ltd, New Delhi 110 008.
3. Dan O'Hair, Rubenstein, H., Stewart, R; *Pocket guide to Public Speaking*; 5th Edition; 2015; Bedford / St. Martin's Publisher.

Course: B.Tech. (M.E)	SYLLABUS	Semester: I
Paper VIII / Subject Name: Concepts of Behavioural Science		Subject Code: BHS982A104
L-T-P-C – 1-0-0-1	Credit Units: 01	Scheme of Evaluation: T

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • to build understanding of the various elements of behavioral science, the way it is conducted and applied in different research	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On completion of this course the students will be expected to: • Understand the various elements of behavioral science, the way it is conducted and applied in different research.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	**Western philosophy to present Behavioural Science** Brief history Sources of knowledge The problem of reliable knowledge Dynamics of development in the Behavioural and Social Sciences	**4**
II.	**Behavioural and Social Science disciplines** Understanding various behavioural and social science disciplines like Psychology, Sociology, Anthropology, Economics, Political Science, Geography, History and Statistics	**4**
III.	**Modes and Methods in the Behavioural and Social Sciences** Experimentation Statistical control Statistically uncontrolled observation	**4**

IV.	**Application of Behavioural Sciences** Three fundamental features of basic research in Behavioural Sciences Exploring examples of behavioural science research	**4**

Text/Reference Books:

- Adams, R. M., Smelser, N. J. & Treiman, D. J. (1982). *Behavioral and social science research: A national resource (Part I)*. Washington: National Academy Press

- O'Grady, M. (2001). *An introduction to behavioural science*. London: Gill & Macmillan.

ROYAL SCHOOL OF ENGINEERING & TECHNOLOGY
B.TECH. IN MECHANICAL ENGINEERING
COURSE STRUCTURE

2nd semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	PHY022C201	Physics	3	0	0	3	3
2	MAT022C202	Mathematics - II	3	1	0	4	4
3	ELE022C203	Basic Electrical Engineering	3	0	0	3	3
4	CSE022C204	Programming for Problem Solving	3	0	0	3	3
5	PHY022C211	Physics Lab	0	0	2	1	2
6	ELE022C213	Basic Electrical Engineering Lab	0	0	2	1	2
7	CSE022C214	Programming for Problem Solving Lab	0	0	2	1	2
8	EVS982A203	Environmental Sciences - II	1	0	0	1	1
9	CEN982A201	Conversation and Public Speaking	1	0	0	1	1
10	BHS982A204	Understanding Self and Others	1	0	0	1	1
		TOTAL	**15**	**1**	**6**	**19**	**22**

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: II**
Paper I / Subject Name: Physics		**Subject Code: PHY022C201**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	*Teaching Learning Process*	*Learning Outcomes*	*Course Evaluation*
The objectives of the course are:- • To make the students understand the basics of fundamental phenomenon of Physics and application in engineering & technology.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On completion of this course the students will be expected to: • Strong foundation in basic concepts of Physics that enables them to understand the applications of Physics in technical field.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Prerequisites: Knowledge of basic concepts of (+12) Physics.

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Stress and Strain, Hooke's law, Types of elasticity, Equivalence of a shear to a compression and an extension at right angles to each other, Relation connecting the elastic constants. Dielectrics And Magnetic Material: Dielectric Constant and Dielectric Susceptibility of a material, Polarizability and Polarization, Different types of Polarization, Magnetisation, Classification: Ferro, Dia and Paramagnetism. Magnetisation curves B-H Curves, Hysteresis, Soft and Hard Magnetic Material.	**9**
II.	Weber Fechner law, Units of Loudness- Decibel, Phon, Sone, Absorption coefficient, Reverberation, Reverberation time, Sabine's formula for reverberation time (Derivation not required), Factors affecting acoustics of buildings and their remedies, Design of a Good Acoustical Building Interference of light, Types of Interference (division of wave front and division of amplitude) Polarization, Double refraction, Nichol's Prism. Fresnel and Fraunhoffer diffraction.	**9**
III.	Production of X-rays - Coolidge tube, Origin of X-rays, Types of X-rays – Continuous and characteristic X-rays, Moseley's law. Bragg's law. De-Broglie hypothesis (concept of group velocity and phase velocity), Expression for de-Broglie wavelength in terms of group velocity and phase velocity, Davisson and Germer Experiment, Heisenberg's Uncertainty principle and its applications.	**9**

IV.	Laser Induced absorption, Spontaneous and Stimulated emission, Einstein's coefficients (A & B), Population Inversion, Pumping, Principle of Laser, and Characteristics of a laser beam. Introduction to semiconductor, Semiconductor Laser, Applications of Laser. Optical fibre- Principles and Structure, Propagation of light in optical fibre, Numerical aperture and acceptance angle, Classification of optical fibre - Single and Multimode, Step Index and Graded Index fibre, Loss in fibre, Optical fibre communication system (Block diagram only).	**9**
Total		**36**

Text:

1. *Elements of properties of matter*, Mathur .D.S., S.Chand publication, New Delhi
2. *Electricity and Magnetism*, Tayal D.C, Publisher, Himalaya Publishing House,New Delhi
3. *Geometrical and Physical Optics*, Chakraborty, P.K., 3rd Edition, New Central Book agency (P) Ltd, 2005.
4. *Concept of Modern physic;* Arthur Beiser, Shobhit Mahajan , S.Rai.Choudhury, McGraw-Hill education,(India). Private limited.New Delhi. 2009.
5. *A Textbook of Oscillations, Waves and Acoustics, by* M Ghosh & D Bhattacharya, S.Chand publication.

Reference Books:

1. Singh A.K. and Malik Hitendra, *Engineering Physics* –MC.Graw Hill education (India) private limited. New Delhi.

2. Gaur.R.K and Gupta S.L, *Engineering Physics*, Dhanpat rai publication.New delhi 2015.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: II**
Paper II / Subject Name: Mathematics - II		**Subject Code: MAT022C202**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To make the students learn fundamental concepts of ODE and PDE theories and where and how such equations arise in applications to scientific and engineering problems. • To explain most of the physical phenomena from Science and Engineering which are modelled by differential equations. • To teach how to Findand interpret thesolutions of the ODE and PDE appearing in a number of applications to scientific and engineering problems. • To explain how toapply vector algebra and calculus in engineering problems.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On completion of this course the students will be expected to: • Solve problems in ordinary differential equations, dynamical systems, stability theory, and a number of applications to scientific and engineering problems. • Investigate the qualitative behavior of solutions of systems of differential equations and interpret in the context of an underlying model. • be able to understand Vector and its applications in applied sciences • be able to competently use vector as a tool in the field of applied sciences and related fields.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

PREREQUISITE: Concepts of Mathematics I

Detailed syllabus:

MODULES	TOPICS / COURSE CONTENTS	HOURS
I	**Ordinary Differential Equations:** Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.	**12**
II	**First order Partial differential equation:** Partial differential equation of first order, Linear partial differential equation, Non-linear partial differential equation, Homogenous and non-homogeneous partial differential equation with constant co- efficient, Cauchy type,	**12**
III	**Second order Partial differential equation:** Second order partial differential equation, Monge‟s method. The vibrating string, the wave equation and its solution, the heat equation and its solution, Two dimensional wave equation and its solution, Laplace equation in polar, cylindrical and spherical coordinates, potential.	**12**
IV	**Vector Analysis:** Scalar and vector triple products, Scalar and vector products of four vectors, reciprocal vector triad, vector equation of straight line, plane and sphere. Vector function of a scalar variable, differentiation of a vector function, Scalar and vector point functions, Gradient of a scalar point function, Directional derivative, divergence and curl of a vector point function, Idea of line, surface and volume integrals, Green's theorem, Gauss' Divergence Theorem and Stokes' theorem (statements and applications).	**12**
TOTAL		**48**

Text Books:

1. *A text book of Engineering Mathematics*, Bali N. P. and Narayan Iyenger N., Ninth edition, 2016, Laxmi Publication.

Reference Books:

1. Grewal B. S., *Higher Engineering Mathematics*, 43rd edition, 2014, Khanna Publishers.
2. Raisinghannia M.D., *Ordinary and Partial Differential Equations*, 1995, S. Chand and Co., New Delhi.
3. Narayna S., *A Text Book of Vector Calculus*, 2009, S. Chand & Co., New Delhi.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: II**
Paper III / Subject Name: Basic Electrical Engineering		**Subject Code: ELE022C203**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To make students understand the basic electrical terminologies. • To make them familiarize with the basic concepts of d.c., single-phase and three-phase a.c. networks. • To impart about the wiring systems and magnetic circuits. • To impart about the various measuring instruments in Electrical Engineering	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On completion of this course the students will be expected to: • Understand and analyze basic electric and magnetic circuits. • Study the working principles of electrical machines and power converters. • Introduce the components of low-voltage electrical installations.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Prerequisites:

- Basic concepts of D.C. networks of Class XII
- Basic concept of Electromagnetic Induction and A.C. Fundamentals etc.

Detailed Syllabus

Modules	Topics / Course content	Hours
I.	**DC Circuits:** Definitions of active, passive, linear, nonlinear circuit elements and networks. Electrical circuit elements (R, L and C), voltage and current sources. Kirchhoff's laws, nodal & mesh analysis, voltage &current sources, network theorems- superposition, Thevenin's, Norton's and Maximum Power Transfer theorems.	**9**
II.	**AC Circuits:** Waveforms of alternating voltages and currents, instantaneous,average and RMS values, form factor & peak factor, forms of representation of alternating quantities, concept of phasor & phasor diagrams, Concept oflead & lag, reactance & impedances. Representation of sinusoidal waveforms, peak and r.m.s values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L,C, RL, RC, RLC combinations (series and parallel), resonance.	**9**

III.	**Single Phase Transformers:** Principle of operation, EMF equation,losses and efficiency. **DC machines:** Electromechanical Energy Conversion, EMF and torque equations, Classification, characteristics and applications of various types of d.c. motors.	**9**
IV.	**Electrical Installations:** Basic knowledge of domestic wiring, types of cables (names only),types of wiring; circuit layouts- single phase AC mains to DB; 3phase connections; accessories- main switch, ceiling rose, fuse,MCB etc. Earthing- purpose & methods. Batteries. **AC 3-Phase:** Concepts of 3-phase AC, connections, phase & line values in star &delta connections, solutions of simple 3-phase balanced circuits with resistive & reactive loads, 3-phase power, and phase sequence. **Instruments:** Classification of instruments, essentials of indicating type instruments- deflecting torque, controlling torque, damping; types of indicating instruments, MC & MI type ammeters & voltmeters	**6**
Total		**40**

Text Books:

1. *A Text Book of Electrical Technology*, Thereja, B.L., 1st Edition revised, 2008, S Chand & Company Ltd. Ram Nagar; New Delhi.
2. *Basic Electrical Engineering*, D. P. Kothari, I. J.Nagrath, 3rd Edition, 2009, Tata McGraw-Hill

Reference Books:

1. D. C. Kulshreshtha, *Basic Electrical Engineering*, 1st Edition, 2009, McGraw-Hill
2. E. Hughes, *Electrical and Electronics Technology*, 10th Edition, 2011,Pearson Publication

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: II**
Paper IV / Subject Name: Programming for Problem Solving		**Subject Code: CSE022C204**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To give the students an introduction to the Computers and Computing environments. • To give the students exposure to computer programming. • To give the students exposure to the C programming language and basic and advanced concepts of C programming. • To make the students capable of using C programming to solve basic as well as advanced computing problems.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On completion of this course the students will be expected to: • Learn about the fundamentals of Computers. • Have an exposure to the problem solving approach through programming. • Understand about the various constructs of programming. • Have a detailed understanding about writing good programs and algorithms and draw flowcharts.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

DETAILED SYLLABUS

Modules	Course content	Hours
I	**Fundamentals of Computers and Computing Concepts** History of computers and computing, generations of computers, classification, Anatomy of a Computer System. Software and Operating Systems for Computers. Number systems. Basic idea of Computer Algorithms and Flow Charts	**9**
II	**C Programming Fundamentals** History and importance of C language, Basic structure of programs, programming style, execution of C programs. Character set, Tokens, Keywords and Identifiers, Constants, variables, data types, statements, comments, declaration of storage class, assigning values to variables. Managing I/O, reading and writing characters, formatted Input/output. Arithmetic operators,	**9**

	relational operators, logical operators, assignment operators, increment & decrement operators, conditional operators, bitwise operators, special operators	
III	**Decision Making, Branching, Lopping, Arrays & Strings** Importance of decision making, decision making with if statement, if-else statement, nested if-else statements, switch-case statement, goto statement, examples. Importance of iterative statements, the while statement, do-while statement, for statement, nested for loop, examples. Significance of Arrays, creation and use of one- & two-dimensional arrays. Declaration and use of string variables, reading and writing strings, operations on strings.	**9**
IV	**Advanced Programming Concepts** Benefits of user-defined functions, creation and use of user-defined functions, parameter passing, return types. Introduction to Pointers, declaration & initialization of pointer variables, accessing a variable through its pointer. Creation of Structures in C, Defining, opening & closing files in C.	**9**
	TOTAL	**36**

Text Book:

1. *Computer Fundamentals and Programming in C*, Reema Thareja, 2nd Edition, 2016, Oxford University Press, Delhi.

Reference Books:

1. E Balaguruswamy, *Computing Fundamentals and C Programming*, 1st Edition, 2017, McGraw Hill.
2. Rajaraman, *Computer Programming in C*, 1st Edition, 1994, Prentice Hall India Learning Private Limited.
3. Venugopal and Prasad, *Mastering C*, 2nd Edition, 2017, Tata McGraw Hill.
4. Yashawant Kanetkar, *Let us C*, 15th Edition, 2017, BPB.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: II**
Paper V / Subject Name: Physics Lab		**Subject Code: PHY022C211**
L-T-P-C – 0-0-2-1	**Credit Units: 01**	**Scheme of Evaluation: P**

Course Objective	*Teaching Learning Process*	*Learning Outcomes*	*Course Evaluation*
The objectives of the course are:- • To make the students understand the basics of fundamental phenomenon of Physics and application in engineering & technology.	1. Demonstration 2. Lab Experiment 3. Quiz 4. Viva-Voce	On completion of this course the students will be expected to: • Build a strong foundation in basic concepts of Physics that enables them to understand the applications of Physics in technical field.	• Continuous Evaluation: 25% (Skill Test, lab copy, viva, lab involvement: Any Three) • Attendance: 5% • End term examination: 70 %

Prerequisites: Knowledge of basic concepts of (+12) Physics.

List of experiments:

Experiment	Experiment Title	Lab Hour
I	Determination of Moment of Inertia of a given solid about its own axis by using M.I.Table	2
II	Determination of Young's Modulus using Searle's Apparatus	2
III	Determination of Rigidity of Modulus of the material of the given rod by Statical method	2
IV	Determination of Powers of Given lenses using an Optical Bench i. Concave Lens , ii Convex Lens	2
V	Determination of Resistance of a Galvanometer using Post Office Box.	2
VI	To determine the mechanical equivalent of heat by Joules calorimeter	2
VII	Determination of ratio of E.M.F of two cells using Potentiometer.	2
VIII	To determination of the focal length of a convex mirror with the help of an auxiliary lens.	2
IX	Determination of Horizontal Components of Earth's Magnetic field using Magnetometer	2

X	Determination of coefficient of Viscosity of water by Capillary Flow Method	2

Text Books:

1. *Elements of properties of matter*, Mathur .D.S., 7th Edition, 1962, S.Chand publication, New Delhi.
2. *Electricity and Magnetism*, Tayal D.C, Publisher, 4th Edition, 2017, Himalaya Pub. House, New Delhi.
3. *Geometrical and Physical Optics*, Chakraborty P.K., 3rd Edition, 2005, New Central Book agency (P) Ltd.
4. *Concept of Modern physics*, Arthur Beiser, Shobhit Mahajan, S. Rai. Choudhury, 6th Edition, 2009, McGraw-Hill education Private limited. New Delhi.
5. *A Textbook of Oscillations, Waves and Acoustics*, M Ghosh & D Bhattacharya, 5th Edition, 2016, S. Chand publication.

Reference Books:

1. Singh A.K. and Malik Hitendra *Engineering Physics*, 2nd Edition, 2016, McGraw Hill education private limited. New Delhi.
2. Gaur R.K and Gupta S.L, *Engineering Physics*, 2015, Dhanpat Rai publication, New Delhi.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: II**
Paper VI / Subject Name: Basic Electrical Engineering Lab		
		Subject Code: ELE022C213
L-T-P-C – 0-0-2-1	**Credit Units: 01**	**Scheme of Evaluation: P**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • to teach the students about basic electrical engineering.	1. Demonstration 2. Lab Experiment 3. Quiz 4. Viva-Voce	On completion of this course the students will be expected to: • Learn about the d.c. networks and theorems • Learn about the a.c. networks and magnetic circuits • Learn about the various instruments and their working principle • Learn about the wiring systems at our homes and the use of other electrical accessories	• Continuous Evaluation: 25% (Skill Test, lab copy, viva, lab involvement: Any Three) • Attendance: 5% • End term examination: 70 %

Prerequisites: Concepts of Physics

Lab	Experiments	Hours
I	To verify Thevenin's Theorem for DC network	2
II	To verify Maximum Power Transfer Theorem for DC network	2
III	Study of R-L-C Series circuit and determine R,L,C, cos Φ,P and Q and draw the phasor diagram	2
IV	Study of R-L-C Parallel circuit and determine R,L,C, cos Φ,P and Q and draw the phasor diagram	2
V	Calibration of a milli-ammeter as a voltmeter.	2
VI	To determine the ohmic and effective resistance (armature winding)	2
VII	To study the characteristics of a filament lamp	2
VIII	To measure the power in a single phase load using one wattmeter	2
IX	To measure the insulation resistance using Megger	2
X	Demonstration of house wiring	2

XI	Demonstration of house wiring	2
	TOTAL	**20**

Text Books:

1. *Basic Electrical Engineering*, Chakrabarti, Nath, Chanda, 1st Edition, 2008, Tata McGraw-Hill Education Pvt. Ltd. India; New Delhi.
2. *A Text Book of Electrical Technology*, Thereja, B.L., 1st Edition revised, 2008, S Chand & Company Ltd. Ram Nagar, New Delhi.

Reference Books:

1. Cotton H, *Advanced Electrical Technology*, 7th Edition, 2011, Reem Publications Pvt. Ltd., New Delhi.
2. Smith, Parker, *Problems in Electrical Engineering*, 9th Edition, 2003, CBS Publisher & Distributor; Delhi.
3. Toro, V.D, *Electrical Engineering Fundamentals*, 2nd Edition, 2015, Prentice Hall India Learning Private Limited, Delhi.
4. Cogdell, J.R, *Foundations of Electrical Engineering*, 2nd Edition, 1995,Pearson Higher Ed, USA.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: II**
Paper VII / Subject Name: Programming for Problem Solving Lab		**Subject Code: CSE022C214**
L-T-P-C – 0-0-2-1	**Credit Units: 01**	**Scheme of Evaluation: P**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To make the student learn about problem solving techniques through C programming language. • To teach the student to write good programs in C. • To enhance the analyzing and problem solving skills.	1. Demonstration 2. Lab Experiment 3. Quiz 4. Viva-Voce	On completion of this course the students will be expected to: • Read, understand and trace the execution of programs written in C language. • Write the C code for a given algorithm. • Implement Programs with pointers and arrays, perform pointer arithmetic, and use the pre-processor. • Write programs that perform operations using derived data types.	• Continuous Evaluation: 25% (Skill Test, lab copy, viva, lab involvement: Any Three) • Attendance: 5% • End term examination: 70 %

Prerequisites: None

Detailed Syllabus:

Minimum 20 Laboratory experiments based on the following-

1. Character set, Tokens, Keywords and Identifiers, Constants, variables, data types, statements, comments, declaration of storage class, assigning values to variables.
2. Managing I/O, reading and writing characters, formatted Input/output.
3. Arithmetic operators, relational operators, logical operators, assignment operators, increment & decrement operators, conditional operators, bitwise operators, special operators.
4. Importance of decision making, decision making with if statement, if-else statement, nested if-else statements, switch-case statement..
5. Importance of iterative statements, the while statement, do-while statement, for statement, nested for looping.
6. Significance of Arrays, creation and use of one & two dimensional arrays
7. Declaration and use of string variables, reading and writing strings.
8. Benefits of user-defined functions, creation and use of user-defined functions, parameter passing, return types.
9. Use of Pointers, declaration & initialization of pointer variables, accessing a variable through its pointer.
10. Defining, opening & closing files in C.

Text Book:

1. *Computer Fundamentals and Programming in C*, Reema Thareja, 2nd Edition, 2016, Oxford University Press, Delhi.

Reference Books:

1. E Balaguruswamy, *Computing Fundamentals and C Programming*, 1st Edition, 2017, McGraw Hill.
2. Rajaraman,*Computer Programming in C*, 1st Edition, 1994, Prentice Hall India Learning Private Limited.
3. Venugopal and Prasad, *Mastering C*, 2nd Edition, 2017, Tata McGraw Hill.
4. Yashawant Kanetkar,*Let us C*, 15th Edition, 2017, BPB.

Course: B.Tech. (M.E)	SYLLABUS	Semester: II
Paper VIII / Subject Name: Environmental Sciences - II		Subject Code: EVS982A203
L-T-P-C – 1-0-0-1	Credit Units: 01	Scheme of Evaluation: T

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To create awareness about the importance of environment • To learn the effect of technology on the environment and ecological balance	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On completion of this course the students will be expected to: • Know the importance of environmental studies and methods of conservation of natural resources. • Explain the causes, effects and control measures of various types of pollution • Recall social issues and legal provision.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I	Types of pollution- Air, water (including urban, rural, marine), soil, noise, thermal, nuclear; Pollution prevention; Management of pollution– Rural /Urban/Industrial waste management [with case study of any one type, e.g., power (thermal/nuclear), fertilizer, tannin, leather, chemical, sugar),	3
II	Solid/Liquid waste management, disaster management	3
III	Problems relating to urban environment- Population pressure, water scarcity, industrialization, remedial measures	3
IV	Climate Change – reasons, effects, (global warming, ozone layer depletion, acid rain) with one case study; Legal issues – Environmental legislation (Acts & issues involved), Environmental Ethics; Environmental monitoring, covering, Monitoring – Identification of Environment	3
	Total	12

Text Book:

1. *Perspectives in Environmental Studies*; Kaushik, A., Kaushik, C.P., 4th Edition, 2014, New Age International (P) Ltd. Publishers, New Delhi – 110 002.

Reference Books:

1. Sinha, J., *Environmental Science*, 1st Edition, 2011, Galgotia Publication Pvt Ltd, Darya Ganj, Delhi 110002.
2. Agarwal, R.K., *Environment & Ecology*, 1st Edition, 2008, Krishna Prakashan Media (P) Ltd, Meerut, India.

3. Miller, T.G., Spoolman, S., *Environmental Science*, 15th Edition, 2014, Cengage Learning, 20 Channel Street, Boston, MA 02210, USA.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: II**
Paper IX / Subject Name: Conversation and Public Speaking		**Subject Code: CEN982A201**
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To prepare students for a variety of academic and other situations in which formal presentations are required. • Topics will include cultural conventionsand speech, perceptions of others, and techniques of oralpresentation and persuasion. Students will learn how to research, outline, and deliver short, informal presentations as well as longer speeches. • To develop and strengthen skills in preparing and presenting public oral presentations in a variety of situations	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On completion of this course the students will be expected to: • Be prepared for a variety of academic and other situations in which formal presentations are required. • Learn cultural conventions and speech, perceptions of others, and techniquesof oral presentation and persuasion. Students will learn how to research, outline, and deliver short, informal presentations as well as longer speeches. • Develop and strengthen skills in preparing and presenting public oral presentations in a variety of situations.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Periods
I.	**Speaking Skills** Speaking-The Art of Speaking, Goals, Speaking Styles, Speaking Process, Importance of Oral Communication, Choosing the form of Communication, Principles and Guidelines of Successful Oral Communication, Barriers to Effective Oral Communication, Three aspects of Oral Communication- Conversing, Listening and Body Language, Intercultural Oral Communication	**3**
II.	**Conversational Skills : Listening and Persuasive Speaking** Introduction, Conversation- Types of Communication, Strategies for Effectiveness, Conversation Practice, Persuasive Functions in Conversation, Telephonic Conversation and Etiquette, Dialogue Writing, Conversation Control	**3**
III.	**Transactional Analysis** The Role of Intonation, Strokes, Psychological Characteristics of Ego States (The	**3**

	Parent, The Adult, The Child), Structure and Aspects of Human Personality, Analysis Transactions- Complementary Transactions, Crossed Transactions, Duplex or Ulterior Transactions, How to Identify the Ego States of the Interacting Individuals, How to Manage Conversations, Structural Analysis, Certain Habits of Ineffective Conversationalists	
IV.	**Business Presentation and Public Speaking** Business Presentation and Speeches–Difference, Elements of a Good Speech-Planning, Occasion, Audience, Purpose, Thesis, Material, Organising and Outlining a Speech Outline, Types of Delivery, Guidelines for Delivery–Verbal Elements, Non-Verbal Elements, Vocal Elements, Visual Elements, Controlling Nervousness and Stage Fright	**3**
	TOTAL	**12**

Text Books:

1. *Business Communication*; Raman, Meenakshi & Singh, Prakash; 2nd Edition; 2012; Oxford University Press, New Delhi 110 001.

Reference Book:

1. Raman, Meenakshi & Sharma, Sangeeta; *Technical Communication: Principles and practice*; 2nd Edition; 2011; Oxford University Press, New Delhi 110 001.
2. Sengupta, Sailesh; *Business and Managerial Communication*; 1st Edition; 2011; PHI Learning Pvt. Ltd, New Delhi 110 001.
3. Mehra Payal; *Business Communication for Managers*; 1st Edition; 2012; Pearson India Education Services, New Delhi 110 017.

Course: B.Tech. (M.E)	SYLLABUS	Semester: II
Paper X / Subject Name: Understanding Self and Others		Subject Code: BHS982A204
L-T-P-C – 1-0-0-1	Credit Units: 01	Scheme of Evaluation: T

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To provide students insight into the various aspects of self and how one perceives and comprehends other's behavior r in the light of their present appearance	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On completion of this course the students will be expected to: • Get an insight into the various aspects of self and how one perceives and comprehends other's behavior in the light of their present appearance.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus

Modules	Content	Hours
I	**Self and Identity** Separated and Connected perspective Immersed and Distal perspective Self-concept, self-esteem and self-efficacy Personal and social identity	3
II	Structure and functions of identity Continuity and differentiation Identity crisis: Erikson and Marcia Quarterlife crisis- a new concept of understanding young people's difficulties in transitioning to adulthood	3
III	Social perception Making sense and categorizing information from environment Person schemas and group stereotypes	3
IV	Attribution Attribution theory Dispositional versus situational attributions Inferring dispositions from acts Co-variation model of attribution Attributions for success and failure Bias and error in attribution Over-attribution to dispositions Focus of attention bias Actor observer difference Motivational biases Cultural basis of attributions	3

Text Books:

1. Baron, R. A.& Branscombe, N. R.,*Social Psychology*, 13th Edition, 2012, US Pearson.

2. Baumeister, R. F., *Self-concept, self-esteem and identity*., 1999 In Varerian, J. D., Barbara, W. A. & Warren, J. H. (Eds*), Personality: Contemporary Theory and Ethnicity*, (pp. 339-375). US: Nelson-Hall Publishers

Reference Books:

1. Leary, M.R. & Tangney, J. P., Handbook of Self and Identity, 2012, New York: The Guilford Press.

ROYAL SCHOOL OF ENGINEERING & TECHNOLOGY
B.TECH. IN MECHANICAL ENGINEERING
COURSE STRUCTURE

3rd semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MAT022C301	Mathematics III	3	1	0	4	4
2	ECE022C306	Basic Electronics Engineering	3	0	0	3	3
3	MEE022C303	Engineering Mechanics	3	1	0	4	4
4	MEE022C304	Primary Manufacturing	3	0	0	3	3
5	MEE022C305	Basic Thermodynamics	3	1	0	4	4
6	BIO022G301	Biology for Engineers	2	0	0	2	2
7	MEE022C314	Primary Manufacturing Lab	0	0	2	1	2
8	MEE022C319	Machine Drawing Lab	0	0	4	2	3
9	CEN982A301	Career Oriented Communication	1	0	0	1	1
		TOTAL	**18**	**3**	**6**	**24**	**26**

Approved by:

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: III**
Paper I / Subject Name: Mathematics III		**Subject Code: MAT022C301**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To provide the fundamentals & concept of probability theory. • To introduce the basic concepts of one dimensional and two-dimensional Random Variables. • To provide information about Estimation theory, Correlation, Regression and Testing of hypothesis. • To derive appropriate numerical methods to solve algebraic and transcendental equations. • To develop appropriate numerical methods to approximate a function.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • solve an algebraic or transcendental equation using an appropriate numerical method • approximate a function using an appropriate numerical method • solve a differential equation using an appropriate numerical method • evaluate a derivativeat a value using an appropriate numerical method • understand the importance of random variables and probability distributions and applications.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

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Prerequisites:

- Sets and elements of Sets, Operation on Sets, Algebra of Sets.

Detailed syllabus:

MODULES	TOPICS / COURSE CONTENTS	HOURS
I	**Probability:** Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.	**12**
II	**Statistics:** Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis -Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parametersfor these three distributions, Correlation and regression – Rank correlation. Curve fitting bythe method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.	**12**
III	**Numerical Methods-I:** Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae. Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.	**12**
IV	**Numerical Methods-II:** Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Numerical solution of ordinary differential equations: Taylor's series, Euler's methods. Runge-Kutta method of fourth order for solving first and second order equations. Predictor-corrector methods.	**12**
TOTAL		**48**

Text Books:

1. Hoel P. G., Port S. C. and Stone C. J., *Introduction to Probability Theory*, 2003, Universal Book Stall.
2. Satry S. S, *Introductory Methods of Numerical Analysis*, 4th edition, 2005, PHI.

Reference Books:

1. Grewal B. S., *Higher Engineering Mathematics*, 43rd edition 2014, Khanna Publishers.
2. Bali N. P. and Narayan Iyenger N ,*A text book of Engineering Mathematics*, 9th edition, 2016, Laxmi Publication.
3. Kreyszig E. *Advanced Engineering Mathematics*, 9th edition, 2011, Wiley Eastern Ltd.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: III**
Paper II / Subject Name: Basic Electronics Engineering		**Subject Code: ECE022C306**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To provide an overview of electronic device components to Mechanical engineering students	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Understand the principles of semiconductor devices and their applications. • Design an application using Operational amplifier. • Understand the working of timing circuits and oscillators. • Understand logic gates, flip flop as a building block of digital systems. • Learn the basics of Electronic communication system.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Semiconductor Devices and Applications: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.	**10**

II.	Operational amplifier and its applications: Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator. Timing Circuits and Oscillators: RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.	**12**
III.	Digital Electronics Fundamentals :Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.	**10**
IV.	Electronic Communication Systems: The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.	**8**
Total		**40**

Text /Reference Books:

1. Floyd ," *Electronic Devices"* Pearson Education 9th edition, 2012.
2. R.P. Jain , "*Modern Digital Electronics*" , Tata Mc Graw Hill, 3rd Edition, 2007.
3. Frenzel, " *Communication Electronics: Principles and Applications*" , Tata Mc Graw Hill, 3rd Edition, 2001

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: III**
Paper III / Subject Name: Engineering Mechanics		**Subject Code: MEE022C303**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To introduces some basic principles of engineering mechanics in as simple a manner as possible.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • A basic understanding of the laws and principles of mechanics. • The ability to analyse and solve simple problems in mechanics. • An understanding of the assumptions and limitations of the approaches used.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Force: Classification of forces; Co-planar concurrent & Co-planar parallel forces; Free body diagram; Resultant of forces ; Parallelogram , Triangle & Polygon Laws of forces : Resolution of forces ; Lami's Theorem; Varignon's theorem : Principle of Moments ; General conditions of equilibrium; Moment and Couple;	**10**
II.	Centroid and Centre of gravity of axes and composite areas; Determination of C.G. of plane figures and areas. Area moment of inertia and mass moment of inertia for plane figures and bodies. Simple problems	**10**
III.	Dry friction; Laws of friction; Friction in inclined planes and wedges. General plane motion –Velocity and Acceleration, D'Alembert's Principle and dynamic equilibrium, Work and energy, Impulse and momentum.	**10**
IV.	Classification and Analysis of Trusses & Frames; Methods of Joints and Graphical methods. Simple problems.	**10**
Total		**40**

Text Books:

1. S. Timoshenko & D.H. Young, *Engineering Mechanics*, 5 edition, 2017, McGraw Hill Education.
2. K L Kumar, *Engineering Mechanics*, 2003, Tata McGraw-Hill Education, 2003
3. B. Bhattacharya, *Engineering Mechanics*, 2nd edition, 2014, Oxford University Press

Reference Books:

1. Irving H. Shames, *Engineering Mechanics – Statics and Dynamics,* 4th edition (2005) Pearson Education India
2. Russell C. Hibbeler, *Engineering Mechanics: Statics and Dynamics,* 12th edition, 2015, Prentice Hall.
3. J.L Mariam & L.G. Kraige, *Engineering Mechanics: Statics*, 7th edition, 2013, Jon Wiley & Sons, Inc.

Course Outcomes:

On successful completion of the course students will be able to:

1. A basic understanding of the laws and principles of mechanics.
2. The ability to analyse and solve simple problems in mechanics.
3. An understanding of the assumptions and limitations of the approaches used.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: III**
Paper IV / Subject Name: Primary Manufacturing		**Subject Code: MEE022C304**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To make the students understand fundamentals of casting. • To provide insight into sand casting and introduce other casting processes • To impart fundamentals of gas welding and arc welding. • To teach principles of advanced welding processes and their applications • To impart knowledge on bulk forming processes. • To teach the principles and working of lathe, shaper and milling machine.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Know the various basic Manufacturing processes used in industry for converting raw materials into finished products. • Understand the principles and science of various basic manufacturing processes such as casting, welding and forming. • Acquire knowledge about the various tools, equipment, machinery and operations required for these basic manufacturing processes. • Acquire fundamental knowledge of the working and design of lathe, milling machine and shaper. • Understand the application, advantages and limitations of various manufacturing processes.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Manufacturing; Definitions and broad grouping Casting: Definition, Casting Materials Sand mould casting: Moulding sands - composition, properties & testing; Type of patterning; Design of gating system - sprue, runner, ingate & riser; Solidification – centre-line freezing Furnaces: Copula, Resistance furnace, Induction & Arc furnace. Casting Method: Centrifugal casting, Shell mould, Investment casting, Permanent mould casting, Die casting, and Slush casting. Casting defects, types, causes & remedy	**10**
II.	Major grouping of joining processes: welding, brazing and soldering Broad classification of welding processes, types and principles Gas welding & thermit welding, Arc welding, Submerged arc welding, TIG & MIG, Plasma arc welding, Spot & butt welding, Hot forge welding, Friction welding, Pressure & percussion welding Ultrasonic welding, Laser beam welding, Electron beam welding Welding defects, types, causes & remedy	**10**
III.	Metal Forming: Hot and cold working of metals, classification of forming processes Rolling: Pressure and forces, Types of rolling mills, rolling defects Forging: Smith forging, Drop forging, Press forging, Machine forging, Forging defects Extrusion: Direct, Indirect, Impact, extrusion of tubes Sheet metal working: Bending, shearing, blanking & punching.	**10**
IV.	Machining Processes: Lathe – Functions, Classification & operations; Drilling Machine – Functions, Classification & operations Milling Machine – Functions, Classification & operations Finishing Processes	**10**
Total		**40**

Text Books:

1. P.N Rao, *Manufacturing technology, Foundry, Forming & Welding,* Tata McGraw-Hill Education, 1992
2. A Ghosh & A Mullick, *Manufacturing Science*, 2nd Edition, 2010, East West Press
3. Choudhury H S K, *Elements Of Workshop Technology Vol-1(Manufacturing Processes)*, Media Promoters, 2008

Reference Books:

1. R K Jain. *Production Technology: Manufacturing Processes, Technology and Automation,* 17th edition, 2004, Khanna Publishers
2. E.P Degarmo, Black & Kohser, *Materials & processes in manufacturing*, 11th edition, 2013, Wiley
3. S.K Sharma & S Sharma, *Manufacturing processes*, I.K International, 2013
4. S Kalpakjian; *Manufacturing Engineering & Technology*, 4th edition, Pearson Education India.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: III**
Paper V / Subject Name: Basic Thermodynamics		**Subject Code: MEE022C305**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To provide understanding about work and heat interactions, and balance of energy between system and its surroundings • To elaborate the applications of First law to various energy conversion devices • To provide understanding in evaluating the changes in properties of substances in various processes • To show the difference between high-grade and low-grade energies and II law limitations on energy conversion	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • To apply energy balance to systems and control volumes, in situations involving heat and work interactions • To evaluate changes in thermodynamic properties of substances • To evaluate the performance of energy conversion devices • To differentiate between high grade and low-grade energies. • To do the thermodynamics modelling of simple systems fro design and performance prediction.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.	**10**
II.	Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables: Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.	**10**
III.	First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.	**10**
IV.	Clausius inequality; Definition of entropy S; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes. Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapour compression cycle and comparison with Carnot cycle.	**10**
Total		**40**

Text Books:

1. P K Nag, *Engineering thermodynamics*, 6th edition, 2017, McGraw Hill Education
2. E. Rathakrishnan, *Fundamentals of Engineering Thermodynamics*, 2nd Revised edition, 2005, PHI Learning Private limited, New Delhi

Reference Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., *Fundamentals of Thermodynamics*, 6th Edition, 2003, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, *Fundamental of Engineering Thermodynamic*, John Wiley and Sons.
4. Cengel and Boles, *Fundamentals of Thermodynamics*, 4th edition, 2001, Tata McGraw Hill Publication

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: III**
Paper VI / Subject Name: Biology for Engineers		**Subject Code: BIO022G301**
L-T-P-C – 2-0-0-2	**Credit Units: 02**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To impart necessary back ground of biological science for facilitating the understanding emulation of biological processes in various applications in the field of engineering such as neural networks, etc. • To impart basic understanding of cell structure, cell functioning and processes • To create the awareness of genetic process of evolution and its relevance to engineering applications.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • To pursue their career in the areas of MEMS, biomedical engineering, research in genetic and evolutionary algorithms and their applications to optimisations , neuro-fuzzy systems and related heuristic algorithm.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Cell biology- cell organelles, function of mitochondrion, Golgi bodies, endoplasmic reticulum, nucleus, chromosomes DNA, ribosomes RNA, anabolism, catabolism, metabolism, cell reproduction and differentiation.	**6**
II.	Human Biology, Protien systhesis,stem cells, Tissue engineering, genetics and mutation, genomes, tissues**.**	**8**
III.	Haman brain physiology, neurophysiology- nerve cells and assembly of cell body, axon fibre, dendrites, mylian sheath, synapse between two or more neurons, inhibitory and excitatory neurons, neuro-transmitters- cortisol, epinephridine, nor-ephridine, cerotonin, oxytocin, beta endorphins etc.	**8**
IV.	Mechano-chemistry-cytoskeleton, bioremediation, bio-sensors, Immuno response of a living organism and human beings and Enzymes and application of enzymes in medical and bioengineering applications.	**8**
Total		**30**

Text :

1. S. ThyagaRajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, Richard W. Thilagaraj, S. Barathi, and M. K. Jaganathan, "Biology for Engineers," Tata McGraw-Hill, New Delhi, 2012.

Reference Book:

1. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, "*Biochemistry*," W.H. Freeman and Co. Ltd., 6th Ed., 2006.
2. Robert Weaver, "*Molecular Biology*," MCGraw-Hill, 5th Edition, 2012.
3. Jon Cooper, "*Biosensors A Practical Approach*" Bellwether Books**, 2**004.
4. Martin Alexander, "*Biodegradation and Bioremediation,"* Academic Press, 1994.
5. Kenneth Murphy, "*Janeway's Immunobiology*," Garland Science; 8th edition, 2011.
6. Eric R. Kandel, James H. Schwartz, Thomas M. Jessell, "Principles of Neural Science, McGraw-Hill, 5th Edition, 2012.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: III**
Paper VII / Subject Name: Primary Manufacturing Lab		**Subject Code: MEE022C314**
L-T-P-C –0-0-2-1	**Credit Units: 01**	**Scheme of Evaluation: P**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To provide an understanding of advanced manufacturing methods through hands on session in workshop .	1. Demonstration 2. Lab Experiment 3. Quiz 4. Viva-Voce	On successful completion the student will be able to: • Perform some advanced manufacturing operations	• Continuous Evaluation: 25% (Skill Test, lab copy, viva, lab involvement: Any Three) • Attendance: 5% • End term examination: 70 %

WELDING:
1. DEMO ON ALL WELDING POSITIONS (VERTICAL, HORIZONTAL, OVE
2. DISCUSSION ON TIG AND MIG.
3. GAS WELDING: OXY-ACETYLENE GAS WELDING
4. BRAZING & SOLDERING.

MACHINING:
1. DOVE TAIL CUTTING AND FITTING AND V-GROOVE CUTTING.
2. SHAPING MACHINE (QUICK RETURN MECHANISM): DEMO
3. MILLING AND SURFACE GRINDING (DEMO)

TURNING:
1. DRILLING, THREADING, KNURLING.
2. LATHE (CENTER LATHE, ALL GEAR LATHE, CONVENTIONAL LATHE): DEMO

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: III**
Paper VIII / Subject Name: Machine Drawing Lab		**Subject Code: MEE022C319**
L-T-P-C –0-0-2-1	**Credit Units: 01**	**Scheme of Evaluation: P**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To develop hands on skill in technical drawing and Machine Drawing.	1. Demonstration 2. Lab Experiment 3. Quiz 4. Viva-Voce	On successful completion the student will be able to: • Make technical drawing and Machine Drawing.	• Continuous Evaluation: 25% (Skill Test, lab copy, viva, lab involvement: Any Three) • Attendance: 5% • End term examination: 70 %

Total 10 sheets to be drawn, minimum being 8

Sheet 1 : Conversion of isometric views to orthographic views
Sheet 2 : Sectional views
Sheet 3 : Fasteners, bolts and nuts, locknuts
Sheet 4 : Keys, couplings

Assembly drawing

Sheet 5 : Stuffing box
Sheet 6 : Eccentric
Sheet 7 : Screw jack
Sheet 8 : Connecting rod
Sheet 9 : Plumber Block
Sheet 10 : Piston assembly

Text Books:

1. N.D. Bhatt, "*Machine Drawing*", Charotar Publishing House, 2008.

Reference Books:

1. Basudeb Bhattacharya, *Machine Drawing*, Oxford University Press
2. K.L. Narayana, "*Machine Drawing*", 3rd ed., New Age International, 2007.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: III**
Paper IX / Subject Name: Career Oriented Communication		**Subject Code: CEN982A301**
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To adopt different communication strategies to meet different objectives of communication inside the organisation. • To develop a robust communication strategy, the students would be prepared for employment by considering relevant information relating to job requirements.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • To meet different objectives of communication inside the organization .	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Course content/ Topics	Periods
I.	**Communication in organisation** Types of organisation Different purposes of communication in organisations Modes of communication in organisation Levels of communication in organisation Direction of flow of communication in organisation Networks Channels of communication Crisis communication in organisation	4
II.	**Communication strategies for managers** Introduction Different communication strategies for managers Communicating different types of messages- positive, negative, persuasive Team communication Cross-cultural communication Communicating for negotiation Corporate communication Leadership communication Business Etiquettes and Professionalism, Applying Ethics	4

III.	**Written communication** Principles of effective writing Different forms of written communication used in organisations Business Letters- parts of business letters, office order, circular, notice, agenda, minutes. Order, acceptance & cancellation, complaint & adjustment letters. Writing across cultures	4
IV.	**Communication for Employment** Preparing Resumes and Application Messages Planning Targeted Resume Preparing resume Supplementing a Resume Composing Application Messages	**4**

Text/Reference Books:

- Verma, Salini, *Business Communication: Essential Strategies for twenty-first century Managers*. 2015, 2nd Edition, Vikas Publishing House Pvt Ltd. pp 59-86, 119-165, 191-232, 243-259.
- Lehman, Dufrene, Sinha, *BCOM: An Innovative Approach to learning and teaching Business Communication* .2011.Cengage Learning Pvt. Ltd.pp.399-405, 332-355.

ROYAL SCHOOL OF ENGINEERING & TECHNOLOGY
B.TECH. IN MECHANICAL ENGINEERING
COURSE STRUCTURE

4th semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MEE022C401	Applied Thermodynamics	3	1	0	4	4
2	MEE022C402	Mechanics of Materials	3	1	0	4	4
3	MEE022C403	Kinematics & Theory of Machines	3	1	0	4	4
4	MEE022C404	Fluid Mechanics	3	1	0	4	4
5	ELE022C405	Electro-Technology	3	0	0	3	3
6	BSA022A401	Principles of Management & Organisational Behaviour	3	0	0	3	3
7	MEE022C414	Fluid Mechanics Lab	0	0	2	1	2
8	ELE022C415	Electro-Technology Lab	0	0	2	1	2
9	CEN982A401	Communication and Presentation skills	1	0	0	1	1
		TOTAL	**19**	**4**	**4**	**25**	**27**

Approved by:

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: IV**
Paper I / Subject Name: Applied Thermodynamics		**Subject Code: MEE022C401**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To provide understanding about Boilers, gas and vapor cycles and their first law and second law efficiencies • To provide understanding about Gas dynamics of air flow and steam through nozzles • To provide understanding about Reciprocating compressors with and without intercooling • Analyzing the performance of steam turbines	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • The students will get a good understanding of various practical power cycles and heat pump cycles. • They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors • They will understand phenomena occurring in high speed compressible flows	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Classification of boilers, Mountings, Accessories, Evaporation capacity, Equivalent evaporation, Boiler efficiency, Selection of boiler, Heat balance sheet. Combustion Thermodynamics: Theoretical (Stoichiometric) air for combustion of fuels, mass balance, A/F ratio, Combustion efficiency, Exhaust gas analysis.	**10**
II.	Flow of steam through nozzles, Shape of nozzles, Effect of friction, Critical pressure ratio, Super saturated flow, Mass flow rate, Maximum mass flow rate through nozzle, Nozzle efficiency	**10**

III.	Reciprocating compressor, Effect of clearance, Volumetric efficiency, Compression ratio, Methods of improving Thermal efficiency,Compressor work, Multi-stage Compression, Intercooler and Aftercooler, Rotary Compressor, Vane type, Root blower, Screw compressor, Centrifugal compressor, Axial flow compressor, Charging and choking ofcompressors	**10**
IV.	Rankine cycle, Reheating and Regeneration cycles, Binary Vapour cycles. Brayton cycle: Open and closed, Ideal and Actual cycles, Isentropic efficiency, Power output, Methods to improve Thermal Efficiency.	**10**
Total		**40**

Text Books:

1. P K Nag, *Engineering thermodynamics*, 6th edition, 2017, McGraw Hill Education

Reference Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals of Thermodynamics*, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, *Fundamental of Engineering Thermodynamic*, John Wiley and Sons.
4. Cengel and Boles, *Fundamentals of Thermodynamics*, 4th edition, 2001, Tata McGraw Hill Publication

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: IV**
Paper II / Subject Name: Mechanics of Materials		**Subject Code: MEE022C402**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To provide understanding of the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads • To develop proficiency in calculation of the elastic deformation occurring in various simple geometries for different types of loading .	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • To recognize various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components • To evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle of stress and strain, Strain Rosettes, Strain Energy.	**10**
II.	Beams and types transverse loading on beams- shear force and bending moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads. Use of energy theorem to determine deflection of beam, Castigliano's Theorems, Maxwell reciprocal theorem	**10**

III.	Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, stresses and deflection of helical springs. Columns: Euler's formula, concept of equivalent length, eccentric loading, Rankine formula. Theories of failure: Maximum principal stress theory (Rankine's theory), Maximum shear stress theory (Guest's and Tresca's theory), Maximum principal strain theory (St. Venant's theory), Maximum strain energy theory (Haigh's theory), Maximum shear strain energy theory (Mises' and Henkey's theory)	**10**
IV.	Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick cylinders, shrunk fit cylinder Stresses in discs of rotation	**10**
Total		**40**

Text Books:

1. S.S Rattan, *Strength of Materials*, Tata McGraw Hill Publications, 3rd Edition, 2017
2. Ramamrutham. S., *Strength of Materials*, Dhanpat Rai & Sons, 2011

Reference Books:

1. Egor P. Popov, *Engineering Mechanics of Solids*, Prentice Hall of India, New Delhi, 2001.
2. R. Subramanian, *Strength of Materials*, Oxford University Press, 2007.
3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, *Mechanics of Materials*, Tata McGrawHill Publishing Co. Ltd., New Delhi 2005.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: IV**
Paper III / Subject Name: Kinematics & Theory of Machines		**Subject Code: MEE022C403**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To provide the fundamental of the basic components and layout of linkages in the assembly of a System/machine. • To provide understanding of principles involved in the displacement, velocity and acceleration at any point in a link of a mechanism. • To show the motion resulting from a specified set of linkages. • To provide understanding of the basic concepts of toothed gearing and kinematics of gear trains.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Demonstrate an understanding of the concepts of various mechanisms and pairs. • Drawing the velocity and acceleration analysis of simple mechanisms. • Synthesis simple mechanisms for function, path generation and body guidance • Understanding of principle of gears and balancing of rotating masses. • Understanding the principle of gyroscopic effects in machines.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	**Basics of Mechanisms** Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four-bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission Angle – Description of some common mechanisms – Quick return mechanisms, Straight line generators, Dwell mechanisms, Ratchets and Escapements	**08**

II.	**Kinematics of Linkage Mechanism and Synthesis** Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method –Velocity and acceleration polygons – Velocity analysis using instantaneous centres –Computer applications in the kinematic analysis of simple mechanisms – Coincident points – Coriolis component of Acceleration. Synthesis of mechanism – Path Generation, Function generation, Four-bar function generation with three accuracy points, Slider-Crank function generator with three accuracy points	**12**
III.	**Gears and Gear Trains** Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions –Gear tooth action – contact ratio – Interference and undercutting – Non-standard gear teeth – Helical, Bevel, Worm, Rack and Pinion gears [Basics only] – Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains – Differentials – Automobile gear box.	**10**
IV.	**Brakes:** Classifications, Simple block, Band and Internal Expanding shoe bakes **Clutches:** Friction clutches, single plate, multiple plate and cone clutches **Belts:** Types of belts, materials, length of open & cross belt drive, slip & creep of the belt, power transmission by a belt, angle of contact, centrifugal tension, condition for maximum power transmission, initial tension	**10**
Total		**40**

Text Books:

1. S S Rattan, "Theory of Machines", McGraw Hill publications, 4th Edition, 2017
2. Amitabha Ghosh, Asok Kumar Mallik, "Theory of Mechanisms and Machines", East-West Press, 2008

Reference Books:

1. Arthur G Erdman, George N. Sandor, "Mechanism Design: Analysis and Synthesis", Pearson Publication, 4th edition, 2001
2. Gary L. Kinzel, Kenneth J. Waldron, "Kinematics, dynamics & design of machinery", Wiley Publications, 3rd edition, 2016.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: IV**
Paper IV / Subject Name: Fluid Mechanics		**Subject Code: MEE022C404**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • The course on fluid mechanics is devised to introduce fundamental aspectsof fluid flow behavior. • Students will learn to develop steady state mechanical energy balance equation for fluid flow systems, estimate pressure drop in fluid flow systems and determine performance characteristics of fluid machinery.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • To apply Bernoulli principle and compute pressure drop in flow systems of different configurations. • To compute power requirement in fixed bed system and determine minimum fluidization velocityin fluidized bed. • To describe functionof flow metering devices and apply Bernoulli equation to determine the performance of flow- metering devices • To determine and analyze the performance aspectsof fluid machinery specifically for centrifugal pump and reciprocating pump	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	**Introductions:** Significance of flow properties, Classification of fluids based on variation of viscosity, Continuum, No slip condition of viscous liquids. **Fluid Statics:** Fundamental equation in vectoral form, pressure at a point, constant density and temperature solution, unit and scales of pressure measurement, pressure measuring devices, Hydrostatic force on a horizontal plane, Vertical plane, inclined and rough surface, Buoyancy stability of floating and submerged bodies, Metacentre and Metacentric height.	**10**
II.	**Fluid Kinematics and Fluid Dynamics**: Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one- and three-dimensional differential forms)- Equation of streamline – steak line - stream function - velocity potential function - circulation - flow net. Fluid dynamics - equations of motion - Euler's equation along a streamline - Bernoulli's equation, applications - Venturi meter, Orifice meter, Pitot tube. Dimensional analysis - Buckingham's Pei theorem- applications - similarity laws and models.	**10**
III.	**Incompressible Flow:** Viscous flow - Navier - Stoke's equation (Statement only) - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes. (Hagen Poiseulle's equation). Hydraulic and energy gradient - flow through pipes - Darcy - Weisback's equation – pipe roughness -friction factor- Moody's diagram- minor losses - flow through pipes in series and in parallel - Power transmission. Boundary layer flows, boundary layer thickness and boundary layer separation. Drag and lift coefficients.	**10**
IV.	**Compressible Flow:** Equation of state – Speed of sound – Mach number – Mach cone and wave – Stagnation and critical properties – Isentropic temperature, pressure and density ratios – Compressibility correction factor – Area velocity relation through convergent-divergent nozzle - Normal shock wave – Prandtl-Mayer relation - Rankine-Hugoniot equation, Fanno flow, Rayleigh flow.	**10**
Total		**40**

Text Books:

1. C S P Ojha, R Berndatsson & P N Chandramouli, *"Fluid Mechanics and Machinery*", 6th Edition, OXFORD publications, Chennai.
2. S M Yaha, "*Fundamentals of Compressible Flow*", 5th Edition, New Age International (P) Limited, Publishers, New Delhi.
3. Frank M.White, "*Fluid Mechanics*", McGraw-Hill, 7th Edition, New Delhi, 2011.

Reference Books:

1. Irving H.Shames, "*Mechanics of Fluids*", McGraw Hill, 3rd Edition, 2014.
2. Yunus A Cengel& John M. Cimbala, *Fluid Mechanics*, Tata McGraw Hill Edition, New Delhi, 3rd Edition, 2015.
3. Streeter.V.L, and Wylie.E.B, "*Fluid Mechanics*", McGraw Hill, 9th Edition 2010.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: IV**
Paper V / Subject Name: Electro-Technology		**Subject Code: ELE022C405**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To provide knowledge about performance of different DC and AC machines • To familiarize various electrical measuring instruments • To give an overview of electric drives and power electronic control scheme	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • To analyze the performance of dc generators and motors. • To analyze the performance of transformers. • To learn the in-depth knowledge on three phase induction motors. • To analyze the performance of special motors and electrical instruments in real time applications	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Review of DC generators – DC generator on no load – open circuit characteristics – basics of armature reaction and commutation – load characteristics of shunt, series and compound generators – Review of dc motors – characteristics of shunt, series and compound motors – starter – 3 point and 4 point starters – losses in DC machines – power flow diagram – efficiency – applications of DC motors.	**10**
II.	Review of transformers – Real transformer – winding resistance and leakage reactance – equivalent circuit – phasor diagram – voltage regulation – losses and efficiency – open circuit and short circuit test – Autotransformer – saving of copper – 3 phase transformer Principle of indicating instruments – moving coil, moving iron and dynamometer type instruments – extension of range of ammeter and voltmeter using current transformer and voltage transformer –principle and working of induction type energy meter	**10**

III.	Review of alternators – distribution and chording factor – EMF equation – armature reaction – phasor diagram – voltage regulation – predetermination of voltage regulation by EMF method (7 Hrs.) Review of 3-phase induction motor – slip – rotor frequency – equivalent circuit – phasor diagram – torque equation – torque-slip characteristics – losses and efficiency – power flow diagram – no-load and blocked rotor tests – starting of 3-phase induction motors – direct-on-line, auto transformer, star-delta and rotor resistance starting..(8 Hrs.)	**10**
IV.	Electrical Drives - Parts of electrical drives - Choice of electric drives - Status of DC and AC drives - Dynamics of Electric drives - Fundamental torque equations – Speed torque conventions and multiquadrant operation - Components of load torque - Nature and classification of load torque – Steady state stability – load equalisation. (7 Hrs.)	**10**
Total		**40**

Text Books:

1. P.S. Bhimbra, *Electrical Machinery*, 7th edition, 1973, Khanna Publishers
2. D.P. Kothari & I.J. Nagrath, *Electrical Machines*, 2004, Tata McGraw-Hill
3. P.K. Mukherjee & S. Chakrabarty, *Electrical Machines*, 2011, Dhanpat Rai
4. Dubey G.K., *Fundamentals a/Electrical Drives*, 2nd edition, 2010, Narosa

Reference Books:

1. Vincent Del Toro, *Electrical Engineering Fundamentals*, 2 edition (1989), Prentice-Hall of India
2. Hughes, *Electrical technology*, 10 edition (2010), Pearson Education India
3. K. Sawhney, *Electrical and Electronics measuring Instruments*, 2015, Dhanpat Rai & Sons

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: IV**
Paper VI / Subject Name: Principles of Management & Organisational Behaviour		
		Subject Code: BSA022A401
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To provide understanding of the principles of management and their application to the functioning of an organization • To show the dynamics of organizational behavior.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Have a clear understanding of management functions and behavioral aspects in an organization.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	**Introduction to Management and Organizational Behaviour:** Concept, Features, Objectives, Importance of Management, Evolution of Management thought- Management theories, Contributing disciplines to the field of OB, Dependent and Independent variables in OB, OB models.	**8**
II.	**Functions of Management:** **Fundamentals of planning:** process of planning, forecasting, MBO, Decision making **Fundamentals of Organizing**: Process of organizing, Formal and Informal Organizations, Organization structure, Line and Staff Relationships **Fundamentals of Staffing:** Recruitment and Selection Controlling: Types of control, Control process, Techniques of control	**10**
III.	**Foundations of Individual Behaviour:** **Attitude:** Components, Cognitive dissonance theory, major job attitudes **Perception:** Factors influencing perception, Attribution theory, Shortcuts used in Judging others **Personality:** Determinants, Big five model, personality traits relevant to OB **Motivation:** Theories of motivation, Employee involvement **Leadership:** Theories of leadership, Charismatic and Transformational Leadership, Finding and Creating Effective Leaders	**12**

IV.	**Group Behaviour:** Classifying groups, Stages of Group development, Types of Teams **Communication:** Communication process, Organizational Communication, Barriers to effective communication **Power and Politics:** Bases of power, power tactics, political behaviour **Organizational Culture:** creating and sustaining culture, creating a positive organizational culture.	**10**
Total		**40**

Text Books:

1. Robins S.P. and Couiter M., *Management*, Prentice Hall India, 10th ed., 2009.
2. Stoner JAF, Freeman RE and Gilbert DR, *Management*, 6th ed., Pearson Education, 2004.
3. Tripathy PC & Reddy PN, *Principles of Management*, Tata McGraw Hill, 1999.
4. Stephen P. Robins, *Organisational Behaviour*, PHI Learning / Pearson Education, 11th edition.
5. Fred Luthans, *Organisational Behaviour*, McGraw Hill, 11th Edition.
6. Hellrigal, Slocum and Woodman, *Organisational Behaviour*, Cengage Learning, 11th Edition

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: IV**
Paper VI / Subject Name: Fluid Mechanics Lab		**Subject Code: MEE022C414**
L-T-P-C – 0-0-2-1	**Credit Units: 01**	**Scheme of Evaluation: P**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To demonstrate the principles and performance characteristics of flow	1. Demonstration 2. Lab Experiment 3. Quiz 4. Viva-Voce	On successful completion the student will be able to: • measure various properties of fluids and characterizethe performance of fluid machinery	• Continuous Evaluation: 25% (Skill Test, lab copy, viva, lab involvement: Any Three) • Attendance: 5% • End term examination: 70 %

1. Verification of Bernoulli's Theorem Apparatus.
2. Measurement of Coefficient of Discharge of given Orifice and Venturimeters
3. Determination of the performance characteristics of a centrifugal pump
4. Determination of the performance characteristics of Pelton Wheel
5. Determination of the performance characteristics of a Francis Turbine
6. Determination of the performance characteristics of a Kaplan Turbine

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: IV**
Paper VIII / Subject Name: Electro-Technology Lab		**Subject Code: ELE022C415**
L-T-P-C – 0-0-2-1	**Credit Units: 01**	**Scheme of Evaluation: P**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To identify electronics components and instruments. • To develop skills to recognize working principle, construction and types of electrical machines.	1. Demonstration 2. Lab Experiment 3. Quiz 4. Viva-Voce	On successful completion the student will be able to: • Demonstrate the use of transformers and DC machines. • Describe basic concepts of electrical circuits and various theorem	• Continuous Evaluation: 25% (Skill Test, lab copy, viva, lab involvement: Any Three) • Attendance: 5% • End term examination: 70 %

1. LOAD TEST ON A DC SHUNT GENERATOR.
2. LOAD TEST ON A DC SERIES MOTOR.
3. EFFICIENCY OF A SINGLE PHASE TRANSFORMER.
4. V-CURVE OF A SYNCHRONOUS MOTOR.
5. OPEN CIRCUIT AND SHORT CIRCUIT TEST OF ALTERNATOR.
6. PARALLEL OPERATION OF ALTERNATOR.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: IV**
Paper IX / Subject Name: Communication and Presentation skills		**Subject Code: CEN982A401**
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To develop report writing skills after detailed inquiry and investigation, tailored to the context of given situation and audience. • To develop and deliver an effective presentation. • The students will also understand the increasing importance of group communication. They will also get information of the different forms of technology-enabled communication in the 21st century businesses.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Write report tailored to the context of given situation and audience. • To deliver an effective presentation.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Course content/ Topics	Periods
I.	**Writing reports, Business proposals and Business Plans** Formats of reports Developing a report outline Report planning Writing a report Using different visual representations for writing a report Developing an outline for a business proposal Developing an outline for business plan	4
II.	**Designing and developing Business Presentation** Planning an effective Business Presentation,	4

	Organising the content Designing compelling presentation visuals Refining your delivery Special presentation situations	
III.	**Focussing on Group Communication** Increasing focus on groups Characteristics of Effective Groups Group Conflicts Meeting Management	4
IV.	**Technology–enabled communication** Role of Technology-enabled communication in the 21st century businesses Different forms of technology-enabled communication tools used in organisations Telephone, Teleconferencing, Fax, Email, Instant messaging , Blog, podcast, Videos, videoconferencing, social media	**4**

Text/Reference Books:

- Verma, Salini, *Business Communication: Essential Strategies for twenty-first century Manage*rs.. 2015, 2nd Edition, Vikas Publishing House Pvt Ltd. pp 59-86, 119-165, 191-232, 243-259.
- Lehman, Dufrene, Sinha, *BCOM: An Innovative Approach to learning and teaching Business Communication.* 2011.Cengage Learning Pvt. Ltd.pp.399-405, 332-355.

ROYAL SCHOOL OF ENGINEERING & TECHNOLOGY
B.TECH. IN MECHANICAL ENGINEERING
COURSE STRUCTURE

5th semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MEE022C501	Design of Machine Elements	3	1	0	4	4
2	MEE022C502	Material Science	3	0	0	3	3
3	MEE022C503	Heat Transfer	3	1	0	4	4
4	MEE022C504	Power Plant Engineering	3	0	0	3	3
5	MEE022C512	Material Testing Lab	0	0	2	1	2
6	MEE022C513	Heat Transfer Lab	0	0	2	1	2
7	CEN982A501	Ethics and Business Communication	1	0	0	1	1
8	ILD992A503	Constitution of India	1	0	0	1	1
9	xxxxxxG5xxx	Open Elective I (from other schools)	3	0	0	3	3
		TOTAL	**17**	**2**	**4**	**21**	**23**

MEE022G509X	**Open Elective I (for other schools)**	**L**	**T**	**P**	**C**
MEE022G5091	Renewable Energy	3	0	0	3
MEE022G5092	Pollution Control Engineering	3	0	0	3

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: V**
Paper I / Subject Name: Design of Machine Elements		**Subject Code: MEE022C501**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • Development of design management and creative skillswith a perspective to produce successful engineering design. • Development of modeling skills for concept evaluationand detailed design. • Sound understanding of component design and failure perspective. • Development of capability to transform engineering concept to tolerance drawings.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • To demonstrate the ability to approach the design problem in a systematic way to develop feasible design solution. • To transform to concept into a working drawing with well tolerance. • To grasp the and solve the industrial design problems more effectively as a practicing engineer.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Comprehension of opportunity-develop a vision, market opportunity analysis, customer need analysis, competitive analysis. Use of QFD, analytical hierarchical process for need prioritisation, customer sort model, brief introduction to six sigma model and stage gate model. Develop a concept- portfolio planning, functional modelling, product architecture, concept engineering (TRIZ , morphological analysis) Embodiment engineering, physical and analytical modelling, design for X, robust design. Total 7 lectures. Failure perspective – types of failure, fail safe, safe fail design, safety margin, reliability, factor safety, relationship between factor of safety and safety margin. 3 lectures, properties of engineering materials and material selection using ASHBY charts.	**10**

II.	Modelling and load estimation- Load analysis, free body diagrams, Vibration loading, impact loading, stress concentration, fracture ofmaterials, fatigue failure models, fatigue load, estimating fatigue failure criteria, high cycle fatigue, low cycle fatigue, design for uniaxial andmultiaxial failure stresses(4lectures). Shaft (including dynamic effects such as whirling, and torsional vibrations) keys and couplings (4 lectures). Threaded joints and fasteners-I (2 lectures)	**10**
III.	Threaded joints and fasteners-II bolted joints (2 lectures) Welded joints design (3 lectures) Bearing design and lubrication – journal bearings, antifriction bearings (5 lectures)	**10**
IV.	Gear design – spur , helical and bevel gears, worm and worm wheels (3 lectures) Spring design – helical – compression, tension , torsion springs, Belleville washers (3 lectures) Clutches and brakes (2 lectures) Belt drives (2 lectures)	**10**
Total		**40**

Text Books:

1. Robert L Norton, (2018)," Machine design", Pearson publication, 8/e
2. Kevin Otto, Kirsten Wood, (2018) "Product design- Techniques in reverse engineering and new product development", Pearson publications, 7/e,
3. Paul J Drake, Jr, (1999), "Dimensioning and tolerancing handbook", McGraw-Hill Book Company.
4. Michael F. Ashby, "*Material selection in mechanical design*", Butterworth-Heinemann publications.

Reference Books:

1. David G Ulman, (2018), "Mechanical design process", McGraw-Hill Book Company, 6/e.
2. R. C. Juvenall, K M Marshek, (2007), "Fundamentals of Machine Component design", Wiley International Student Version, 4/e

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: V**
Paper II / Subject Name: Material Science		**Subject Code: MEE022C502**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • The main objective of this course is to provide the basic knowledge needed to explore the discipline of materials science and engineering. • To develop the knowledge of how the structure of materials is described technically, including crystallography, microstructure, defects, and phase diagrams. • To develop the knowledge of how the properties of materials are described technically and how material failure is analyzed. • To develop knowledge in various class of materials and their applications.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Understand how materials are formed and their classification basedon atomic arrangement and properties. • Describe the mechanical behavior of metallic systems and its importance. • Selection of materials by using Ashbycharts. • Gain knowledge on various modern metallic and non-metallic materials and its properties.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	**SELECTION OF MATERIALS AND STRUCTURE OF ATOMS AND MOLECULES** Classification of materials. Properties of engineering materials: Mechanical, Thermal, Electrical, Magnetic, Optical. Selection of materials:the basis of material selection, Material selection charts – Youngs modulus Vs Density, Case Study: Material selection for Golf ball print head, materials to minimize thermal distortion in precision devices. Crystal structure of metals, representations of planes and directions in crystals, atomic packing in crystals, calculation of packing density, voids in common crystal structures and imperfections crystals.	**10**
II.	**ELASTIC AND PLASTIC BEHAVIOUR** Elasticity in metals - Mechanism of plastic deformation - critical resolve shear stress, dislocation theory, deformation by slip and twin. Role of yield stress, shear strength of perfect and real crystals - Strengtheningmechanisms - work hardening, grain boundary strengthening, and particle, fibre and dispersion strengthening.	**08**
III.	**PHASE DIAGRAMS AND HEAT TREATMENTS** Introduction - Solid solutions - Intermediate phases - Phase rules - Free energy in intermediate phases - Phase diagrams - Phase changes in alloys - Determination of phase diagrams - Ternary phase diagrams - Coolingcurves - Equilibrium diagrams of Iron and Iron -Carbide diagram – TTT diagram. Definition of structures – Annealing – Normalizing – Tempering – Hardening.	**10**
IV.	**MODERN METTALIC AND NON METALIC MATERIALS** Dual phase alloys - Micro alloyed steels, High Strength Low alloy (HSLA) steel - Transformation induced plasticity (TRIP) steel, Smart materials - Shape memory alloys - Metallic glasses – Quasi crystals and nano crystalline materials. Polymeric materials - Formation of polymer structure - Production techniques of fibre, foams, adhesives and coating - structure and properties and applications of engineering polymers - Advanced structure ceramics, WC, TiC, Al2O3, SiC, Si2N4, CBN and Diamond - Properties, processing and applications. Composite materials: Types, production techniques, structure, properties and applications.	**12**
Total		**40**

Text Books:

1. Raghavan V, *"Materials Science and Engineering",* 6th Edition, 2015, PHI Learning Private Limited
2. G. Narula, K. Narula, V. Gupta, *"Materials Science"*, 1 edition, 2017, McGraw Hill Education
3. Flake.C Campbell**, "***Elements of Metallurgy and Engineering Alloys",* ASM International, 2008.

Reference Books:

1. "Dieter.G.E, "*Mechanical Metallurgy"*, McGraw Hill, Singapore, 2001.
2. Thomas H. Courtney, "*Mechanical Behaviour of Engineering materials"*, McGrawHill, Singapore, 2000

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: V**
Paper III / Subject Name: Heat Transfer		**Subject Code: MEE022C503**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation. • Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations. • The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • formulate and analyze a heat transfer problem involving any of the three modes of heat transfer • obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer • design devices suchas heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer	**10**
II.	Heat convection, basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer- Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.	**10**
III.	Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method.	**10**
IV.	Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and εNTU methods. Boiling and Condensation heat transfer, Pool boiling curve.	**10**
Total		**40**

Text Books:

1. Necati Ozisik, "*Heat Transfer: A Basic Approach*", McGraw-Hill Inc., 1984
2. J Holman, Souvik Bhattacharyya, "*Heat Transfer*", 10th Edition, McGraw Hill, 2017
3. Cengel. Y. A., "*Heat Transfer: A Practical Approach*", McGraw Hill, 2002
4. R K Rajput, "*Heat and Mass Transfer*", S Chand; 2008

Reference Books:

1. Bejan. A., "*Heat Transfer*", John Wiley, 1993
2. Massoud. K., "*Principles of Heat Transfer*", John Wiley, 2002
3. Incropera. F.P., and Dewitt D.P., "*Fundamentals of Heat and Mass Transfer*", John Wiley, Sixth Edition, 2007.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: V**
Paper IV / Subject Name: Power Plant Engineering		**Subject Code: MEE022C504**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To give fundamental knowledge of constructionand working of various types of thermal power plants i.e. steam turbine, gas turbine, nuclear etc.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Understand the different power generation methods, its economics and global energy situation • Apply the basic thermodynamics and fluid flow principles to different power generation methods • Analyze thermodynamic cycles of steam power plant and understand construction, working and significance of its various systems • Analyze thermodynamic cycles of gas turbine power plant, nuclear power plant and jet propulsion systems	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	COAL BASED THERMAL POWER PLANTS I Review of Rankine cycle, Methods of improving efficiency, Layout of modern coal power plant, Super Critical Boilers Steam Turbines: Impulse turbine - velocity diagram, work done and blade efficiency. Pressure compounding and velocity compounding of steam turbine Impulse reaction turbine - Velocity diagram, degree of reaction and Parsons turbine. Back pressure turbine & bleeding, Governing in Steam turbine,	**10**

II.	COAL BASED THERMAL POWER PLANTS II Subsystems of thermal power plants: PF firing and Fluidized bed boilers. Handling of coal and ash. Function of steam condenser – Elements of condensing plant – Sources of air leakage-Surface condenser – Vacuum efficiency – determination of cooling water – Cooling towers & Cooling Ponds.	**10**
III.	DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS Components of Layouts of Diesel power plants and Gas Turbine power plants. Combined Cycle Power Plants, IGCC NUCLEAR POWER PLANTS Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: BWR, PWR, CANDU, Fast Breeder, Safety measures for Nuclear Power plants.	**10**
IV.	RENEWABLE ENERGY POWER PLANT Working of Hydel, Wind, Tidal, Solar photovoltaic, Solar thermal, Geothermal, OTEC, Biogas and fuel cell power systems (Theory only) Power Storage Devices ECONOMICS OF POWER GENERATION Load curve and various factors, cost of power generation.	**10**
Total		**40**

Text Books:

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2. Domkundwar, Arora Domkundwar, "Power Plant Engineering", Eighth Edition, Dhanpat Rai & Co. (P) Limited, 2016
3. R.K. Rajput, A Textbook of Power Plant Engineering, Laxmi Publications; Fifth edition, 2016

Reference Books:

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: V**
Paper V / Subject Name: Material Testing Lab		**Subject Code: MEE022C512**
L-T-P-C – 0-0-2-1	**Credit Units: 01**	**Scheme of Evaluation: P**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To understand the procedure of doing different tests like hardness, compression, torsion, tension and impact etc in various materials	1. Demonstration 2. Lab Experiment 3. Quiz 4. Viva-Voce	On successful completion the student will be able to: • Describe the behavior of materials upon normal external loads. • Predict the behavior of the material under impact conditions. • Recognize the mechanical behavior of materials.	• Continuous Evaluation: 25% (Skill Test, lab copy, viva, lab involvement: Any Three) • Attendance: 5% • End term examination: 70 %

EXPERIMENT NO.	AIM OF THE EXPERIMENT	HOURS
1	Tensile test on mild steel and HYSD bars. Theory Practical	 1 2
2	Compression test on mild steel, cast iron and wood. Theory Practical	 1 2
3	Torsion test on mild steel circular sections Theory Practical	 1 2
4	Shear Test on Mild steel- single and double shear Theory Practical	 1 2
5	Impact test on Mild Steel (Charpy & Izod)) Theory Practical	 1 2
6	Hardness tests on ferrous and non-ferrous metals – Brinell's, Rockwell and Vicker's Theory Practical	 1 2
7	Demonstration of Strain gauges and Strain indicators Theory Practical	 1 2

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: V**
Paper VI / Subject Name: Heat Transfer Lab		**Subject Code: MEE022C513**
L-T-P-C – 0-0-2-1	**Credit Units: 02**	**Scheme of Evaluation: P**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To expose the students to the basic knowledge of heat transfer and help them to develop experimental skills. • To study the concepts, applications of the heat transfer laboratory.	1. Demonstration 2. Lab Experiment 3. Quiz 4. Viva-Voce	On successful completion the student will be able to: • Demonstrate conduction, convection and radiation heat transfer through experiments. • Understand and analyse emissivity and conductivity of different materials. • Examine the performance of heat exchangers.	• Continuous Evaluation: 25% (Skill Test, lab copy, viva, lab involvement: Any Three) • Attendance: 5% • End term examination: 70 %

EXPERIMENT NO.	AIM OF THE EXPERIMENT	HOURS
1	Heat transfer through composite wall	3
2	Emissivity measurement apparatus	3
3	Forced convection apparatus	3
4	Specific heat apparatus (Heat pipe)	3
5	Heat transfer co-efficient for vertical tube (Natural Convection)	3
6	Parallel flow / counter flow heat exchanger	3
7	Boiling heat transfer	3
8	Stefan Boltzmann apparatus	3

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: V**
Paper VII / Subject Name: Ethics and Business Communication		
		Subject Code: CEN982A501
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To introduce students to truthfulness, accuracy, honesty, and reason asessential to the integrity of communication. • Ethics will enable a student to use specific capacities and skills to make moral decisions. • Students should develop, demonstrate and act out their ethical abilities.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Demonstrate ethical awareness, the ability to do ethical reflection, and the ability to apply ethical principles in decision-making	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Prerequisites: Previous knowledge of communication

Detailed Syllabus:

Modules	Topics	Course Contents	Hours
I	**Why ethics in organizational communication?**	Characteristics of Ethical Communication, ethical code in communication, Ethical Perspectives)values, religious, economic, legal, utilitarian, humanistic, dialogic, situational, universalistic), Ethical issues involved in Business communication (honesty, respect, sensitivity to cultural differences)	**3**
II	**What does a professional communicator do?**	Practices and behaviours of a professional communicator, ethical dilemmas (secrecy, whistle blowing, leaks, rumours and gossips, Lying, ambiguity), Strategic approaches to corporate ethics, Ethical communication on the intern	**3**
III	**Areas of Concern**	Ethical communication on the internet, freedom of expression, ethical implication of privacy of electronic mail, Ethics in advertising, Advertising and social responsibility, plagiarism, Social Media and responsible handling.	**3**
IV	**Corporate**	Employee relations and employee communication – key tasks	**3**

	image, PR, CSR and Advertising	and communicative objectives, forms of employee involvement and tools of communication, PR and corporate mission, Advertising, PR and Publicity, Corporate social responsibility, financial communication, customer relations,	
TOTAL			**12**

Text Books:

1. *Business Communication*, Raman, Meenakshi and Singh, Prakash. 2nd Edition, 2012, Oxford University Press, pp. 546-585.
2. *Lean, Ethical Business Communication*, Sundararajan, Binod and Macdonald, Linda, 2017, Oxford University Press, pp 212 – 220.

Reference Books:

1. Sengupta. Sengupta, *Business and Managerial Communication*, 2nd Edition, 2011, Vikas Publishing House Pvt Ltd, pp. 529 – 603.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: V**
Paper VIII / Subject Name: Constitution of India		**Subject Code: ILD992A503**
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To acquaint the students with legacies of constitutional development in India and help them to understand the most diversified legal document of India and philosophy behind it. • To make students aware of the theoretical and functional aspects of the Indian Parliamentary System. • To channelize students' thinking towards basic understanding of the legal concepts and its implications for engineers.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Identify and explore the basic features and modalities about Indian constitution. • Differentiate and relate the functioning of Indian parliamentary system. • Differentiate different aspects of Indian Legal System and its related bodies. • Discover and apply different laws and regulation. • Correlate role of engineers with different organizations and governance models	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Introduction to the Constitution of India, The Making of the Constitution and Salient features of the Constitution. Preamble to the Indian Constitution Fundamental Rights & its limitations.	**5**

II.	Directive Principles of State Policy & Relevance of Directive Principles State Policy Fundamental Duties. Union Executives – President, Prime Minister Parliament. Supreme Court of India.	**5**
III.	State Executives – Governor Chief Minister, State Legislature High Court of State. Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th & 91st Amendments.	**5**
IV.	Special Provision for SC & ST Special Provision for Women, Children & Backward Classes Emergency Provisions. Powers and functions of Municipalities, Panchayats and Co – Operative Societies.	**5**
Total		**20**

Text Books:

1. Durga Das Basu., "Introduction to the Constitution of India", 21st Edition, Lexis Nexis., 2013.

Reference Books:

1. O.M Aggarawala, "Constitution of India", First Edition, Andesite Press, 2015.

Course: Open	**SYLLABUS**	**Semester: V**
Paper IX / Open Elective I / Subject Name: Renewable Energy		
		Subject Code: MEE022G5091
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • The course isdesigned to give knowledge of various renewable energy sources, systems and applications in the present context and need. • To enable the students identify the New Methodologies / Technologies for effective utilization of Renewable Energy Sources.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Understand the importance and applications of Renewable energy sources. • carry out preliminary economic analysis of Renewable energy systems. • Identify the new Methodologies / Technologies for effective utilization of Renewable Energy Sources.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	**Introduction:** World Energy Use, Reserves of Energy Resources, Environmental Aspects of Energy Utilisation, Economics Of Renewable Energy Systems. **Scenario of Renewable Energy (RE) Sources**: Needs of renewable energy, advantages and limitations of RE, Renewable Energy Scenario in Northeast India, Rest of India And Around the World.	**10**
II.	**Solar Energy:** Energy available from the sun, spectral distribution, solar radiation outside the earth's atmosphere and at the earth's surface, solar radiation geometry, Instruments for solar radiation measurements. Solar energy conversion into heat, types of solar collectors, evacuated and non-evacuated solar air heater, concentrated collectors, air heater and cylindrical parabolic collector, solar energy thermal storage, heating and cooling of buildings, solar pumping, solar cooker, solar still, solar drier, solar	**10**

	refrigeration and air conditioning, solar pond, heliostat, solar furnace. Photovoltaic system for power generation	
III.	**Wind Energy:** Wind Data and Energy Estimation, Types of Wind Energy Systems -Performance – Site Selection, Details Of Wind Turbine Generator, Safety And Environmental Aspects. **Biomass Energy:** Biomass Direct Combustion, Biomass Gasifiers, Biogas Plants, Digesters, Ethanol Production, Bio Diesel, Cogeneration, Biomass Applications.	**10**
IV.	**Other Renewable Energy Sources:** Tidal Energy, Wave Energy, Open and Closed OTEC Cycles, Small Hydro, Geothermal Energy, Hydrogen and Storage - Fuel Cell Systems, Hybrid Systems. **Economic Analysis:** Initial and annual cost, basic definitions, present worth calculations, repayment of loan in equal annual instalments, annual savings, cumulative saving and life cycle cost, economic analysis of add on solar system, payback period, clean development mechanism.	**10**
Total		**40**

Text Books:

1. Rai. G.D., *"Non-Conventional Energy Sources",* Khanna Publishers, New Delhi, 2011.
2. Twidell , J.W. & Weir, A., "*Renewable Energy Sources*", EFN Spon Ltd., UK.

Reference Books:

1. Sukhatme. S.P., "*Solar Energy*", Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Godfrey Boyle, "*Renewable Energy, Power For A Sustainable Future*", Oxford University Press, U.K., 1996.
3. Freris. L.L., "*Wind Energy Conversion Systems*", Prentice Hall, UK, 1990.
4. Johnson Gary, L. "*Wind Energy Systems*", Prentice Hall, New York.
5. David M. Mousdale – "*Introduction To Biofuels*", CRC Press, Taylor & Francis Group, USA 2010
6. Chetan Singh Solanki, Solar Photovoltaics, "*Fundamentals, Technologies and Applications*", PHI Learning Private Limited, New Delhi, 2009.

Course: Open	**SYLLABUS**	**Semester: V**
Paper IX / Open Elective I / Subject Name: Pollution Control Engineering		
		Subject Code: MEE022G5092
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To introduce the principles and methods to control air, water and soil pollution to the students. • To help understand primary and secondary air pollutants of global concern, federal regulations and standards, state permit & compliance programs, and available as well as emerging control technologies for environmental pollution.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Understand importance of environment and different types of pollution. • Describe causes and preventive measures against air pollution, water pollution, soil pollution and Noise Pollution. • Know about the federal regulations and standards, state permit & compliance programs, and available as well as emerging control technologies for environmental pollution.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Introduction: Man and Environment: Overview (socio-economic structure & occupational exposures), Scope of Pollution Control Engineering, pollution problems due to urbanization & industrialization Environment and environmental pollution from chemical process industries, characterization of emission and effluents, Environmental Laws and rules, standards. **Pollution Prevention:** Process modification, alternative raw material, recovery of by co-product from industrial emission effluents, recycle and reuse of waste, energy recovery and waste Utilization.	**10**
II.	**Air Pollution:** Causes of air pollution – types & sources of air pollutants- Climatic & Meteorological effect on air pollution concentration- formation of smog and fumigation. **Analysis of Air Pollutants:** Collection and Analysis of Air Pollutantslike: Sulphur dioxide, Nitrogen oxide, Carbon monoxide, Oxidants &Ozone, Hydrocarbons, Particulate Matter. **Air Pollution Control Measures & Equipment:** Control of Particulate Emission – Control of Gaseous Emission – Flue Gas Treatment Methods	**10**
III.	**Water Pollution:** Origin of waste water, Types of water pollutants and their effects. **Different Sources of Water pollution:** Biological Pollution, Chemical Pollutants, Oxygen demanding substances, Physical Pollutants**,** Thermal Waste, Radioactive waste. **Water Pollution & its Control:** Adverse effects on**:** Human Health & Environment, Aquatic life, Animal life, Plant life, Water Pollution Measurement Techniques, Water Pollution Control Equipment & Instruments	**10**
IV.	**Soil and Environment:** **Soil Polluting Agencies & Effect of Solution:** Liquid & Solid Wastes, Domestic & Industrial Wastes, Pesticides, Inorganic & Organic Pollutants, Soil Deterioration, Poor Fertility, Septicity, Ground Water Pollution, Concentration of Infecting Agents in Soil. **Solid Waste Disposal:** Dumping domestic & Industrial Solid Wastes: Advantages & Disadvantages, Incineration: Advantages & Disadvantages, Sanitary Land Field: Advantages & Disadvantages, Management of Careful & Sanitary Disposal of Solid Wastes. **Noise Pollution& Control:** Noise Pollution**:** Intensity, Duration, Types of Industrial Noise – Ill**,** Effects of Noise, Noise Measuring & Control , Permissible Noise**,** Limits.	**10**
Total		**40**

Text Books:

1. C.S. Rao, "Environmental Pollution Control Engineering", New Age International Publishers; Third edition, 2018
2. Turk, J. & Turk, A., "Environmental Science & Environmental Pollution", Prentice-Hall of India, New Delhi.
3. Cooper, C. D., J. D. Dietz, and D. R. Reinhart, "Foundations of Environmental Engineering," Waveland Press, 1990.

Reference Books:

1. Vallero, D., "*Fundamentals of Air Pollution*", 4th Ed; Academic Press.
2. Eckenfelder W.W; "*Industrial Water Pollution Control*", 2nd Ed; McGraw Hill.
3. Kreith F. and Tchobanoglous G., "*Handbook of Solid Waste Management*", 2 Ed; Mc Graw Hill.
4. Tchobanoglous G., Burton F. L. and Stensel H.D., "*Waste Water Engineering: Treatment and Reuse*", 4th Ed; Tata McGraw Hill.
5. "*Pollution Control Acts, Rules, Notifications issued there under*" CPCB, Ministry of Environment and Forest, G.O.I., 3rd Ed.2006.

ROYAL SCHOOL OF ENGINEERING & TECHNOLOGY
B.TECH. IN MECHANICAL ENGINEERING
COURSE STRUCTURE

6th semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MEE022C601	Dynamics of Machines	3	1	0	4	4
2	MEE022C602	Internal Combustion Engines	3	0	0	3	3
3	MEE022D603X	Elective I (Departmental)	3	0	0	3	3
4	MEE022D604X	Elective II (Departmental)	3	0	0	3	3
5	COM022A605	Economics and Accountancy	3	0	0	3	3
6	MEE022C611	Dynamics of Machines Lab	0	0	2	1	2
7	CEN982A601	Effective Workspace Communication	1	0	0	1	1
8	ILD992S603	Essence of Indian Traditional Knowledge	1	0	0	1	1
9	xxxxxxG6xxx	Open Elective II (from other schools)	3	0	0	3	3
		TOTAL	**20**	**1**	**2**	**22**	**23**

MEE022D603X	**Elective I**	**L**	**T**	**P**	**C**
MEE022D6031	Gas Dynamics and Jet Propulsion	3	0	0	3
MEE022D6032	Instrumentation & Control	3	0	0	3

MEE022D604X	**Elective II**	**L**	**T**	**P**	**C**
MEE022D6041	Fluid Machines	3	0	0	3
MEE022D6042	Mechatronic Systems	3	0	0	3

MEE022G609X	**Open Elective II (for other Schools)**	**L**	**T**	**P**	**C**
MEE022G6091	Fundamentals of Automobile Engineering	3	0	0	3
MEE022G6092	3D Modelling & Printing	2	0	2	3

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VI**
Paper I / Subject Name: Dynamics of Machines		**Subject Code: MEE022C601**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To provide fundamentals of the basic components of forces acting over the machine components. • To derive the equation motion of SDOF by using different methods such as energy method, Rayleigh's method and newton's method. • To provide understanding of the response of the system for various unbalances acting on the system • To evaluate the natural frequencies of multi DOF system.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Demonstrate an understanding of turning moment diagrams in various applications. • Demonstrate skills to design flywheel for an IC engine and punching press with the consideration of geometrical and economic constraints. • Participate or lead projects in mechanical system design for the controlling of vibration.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	**Force Analysis** Applied and constraint forces – Free body diagrams – Static equilibrium conditions – Two, three & four members – Static force analysis of simple mechanisms – Dynamic force analysis –Inertia force and Inertia torque – D Alembert's principle – The principle of superposition –Dynamic Analysis in reciprocating engines – Gas forces – Equivalent masses – Bearing loads– Crank shaft torque – Turning moment diagrams – Fluctuation of energy – Fly Wheels –Engine shaking forces.	**08**

II.	**Free and Forced Vibration of SDOF** Basic features of vibratory systems – Degrees of freedom–Natural frequency Derivation of equation motion – newton's method, energy method, Rayleigh's method,– Damped free vibration,- Resonance– Magnification factor, Response of rotating and reciprocating unbalance, support motion, vibration isolation, transmissibility – Critical speeds of shafts – Torsional vibration – Torsionally equivalent shaft – Two and three rotor systems.	**12**
III.	**Two Degrees and Multi Degrees of Freedom System** Torsional vibration of two rotor system, vibrations of two DOF system, semi-definite system, Co-ordinate coupling, vibration absorber-Derivation of influence co-efficient matrix, generalized co-ordinates, Matrix method, Orthogonality principle, Matrix Iteration Method, Dunkerley's method, Holzer's Method,	**10**
IV.	**Dynamics of Governors and CAM** Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force –. Classification of cams and followers – Terminology and definitions – Displacement diagrams –Uniform velocity, parabolic, simple harmonic, cycloidal and polynomial motions **Balancing of Inertia forces and Gyroscopic Action** Balancing of rotating masses, two-plane balancing, determination of balancing masses, balancing of Internal Combustion Engines. Gyro dynamics, free motion of symmetrical gyroscope, gyroscopic moment of a symmetrical gyroscope in regular precession, gyroscopic effects in machines	**10**
Total		**40**

Text Books:

1. Amitabha Ghosh, Asok Kumar Mallik, "Theory of Mechanisms and Machines", East-West Press.
2. V.P.Singh, "Mechanical Vibrations", Dhanpat Rai & Co
3. Rao.J.S. and Dukkipati.R.V. 'Mechanisms and Machine Theory', Wiley-Eastern Ltd., New Delhi, 1992.

Reference Books:

1. S S Rattan, "Theory of Machines", McGraw Hill publications.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VI**
Paper II / Subject Name: Internal Combustion Engines		**Subject Code: MEE022C602**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	*Teaching Learning Process*	*Learning Outcomes*	*Course Evaluation*
The objectives of the course are:- • To develop the concept of heat engine design. • To provide understanding of the working principle of designs of engine sub systems. • To introduce and develop the concepts of engine performance evaluation and testing. • To provide understanding knowledge of the cause, effect and control of emission from I C engine	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • develop clear fundamentals of internal combustion engines • understand the design and functioning of various systems involved in I C Engines. • test and evaluate performance of an I C Engine.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics/ Course content	Hours
I.	Introduction and Classification of Heat Engines. Engine components and working. Two-stroke, four-stroke. Air standard cycles, analysis of Otto, Diesel and Dual engines. Fuel- air cycles and actual cycles. Measurement of speed, torque, fuel consumption, determination of IHP, BHP and FHP, specific fuel consumption, determination of indicated thermal efficiency, brake thermal efficiency and mechanical efficiency, plot of efficiency vs. speed curves. Speed- torque curve with *bsfc* muscle curve, Morse Test.	**10**

II.	Classification of hydrocarbons in fuels, Classification and desirable characteristics of I.C. engine fuels, Rating of S.I. and C.I. engine fuels, Laboratory method of determining Octane and Cetane Number. Alternative fuels (liquid, gaseous, etc.). Analysis of combustion product, HCV and LCV of the fuels. Combustion in I C Engines: Homogenous and heterogenous mixture, Stages of Combustion in S.I and C.I engines, Flame front propagation, Parameter influencing combustion, Detonation and knocking in S.I. and C.I. engines and their preventions, Combustion chamber design basics in SI Engine & CI Engines	**10**
III.	Working principle of a carburettor, Analysis of simple carburettor, Mechanical fuel injection system: classification and working. Types of Injection pumps and nozzles. Mechanism of Spray formation, Calculation of fuel spray velocity. EFI system: working, sensors, MPFI, GDI Ignition systems in I.C. engines (Battery, magneto and electronic), ignition timing and spark advance.	**10**
IV.	Supercharging: Types of superchargers, methods, effect and limitations of supercharging, Turbo charging, Downsizing and down-speeding of IC engines. Emission norms, Emission from IC Engines: classification (Exhaust and Non-exhaust), formation, control methods - catalytic and thermal converters, EURO and BS Norms Lubrication System: Function, types and working principle, properties of lubricating oil. Cooling system: Function, Types and working principle EMS (Engine Management System)	**10**
Total		**40**

Text Books:

1. V Ganesan, "Internal Combustion Engines", Mc Graw Hill Education (India) Pvt. Ltd., 4th Edition, 2012
2. M L Mathur, R. P. Sharma, "Internal Combustion Engines", Dhanpat Rai & Sons, 2014
3. H. N. Gupta, "Fundamentals of Internal Combustion Engines", PHI Learning Pvt. Ltd. University Press. 2nd edition, 2013
4. J. B. Heywood, "Internal Combustion Engine fundamentals", Mc Graw Hill Education, 1 edition, 2017

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VI**
Paper III (Elective I) / Subject Name: Gas Dynamics and Jet Propulsion		
		Subject Code: MEE022D6031
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- To provide understanding of • The thermodynamic cycles of jet engines. • The compressiblefluid flow in inlets and compressors and turbines. • The combustion physics in combustion chambers. • the rationale behind several types of jet engines. • The ability to analyze jet engines; determine propulsion efficiency and design inlets and nozzles.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Explain basic concepts of gas dynamics and describe the basic fundamental equations of one-dimensional flow of compressible fluid and isentropic flow of an ideal gas. • Analyze the steady one-dimensional is entropic flow, frictional flow and isothermal flow and express the concepts of steady one-dimensional flow with heat transfer. • Discuss the effect of heat transfer on flow parameters. • Describe the jet propulsion engines. • Describe the basic concepts of rocket propulsion	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	**Thermodynamic analysis cycles:** Simple Gas Turbine and Practical Gas Turbine cycles – Heat Exchanger cycle – Reheat cycle – Intercooled cycle etc. –- Intercooled cycle with Heat Exchanger - Intercooled cycle with Heat Exchanger and Reheat. **Combustion Systems:** Parts of Combustion Systems - Factors effecting Combustion Chamber Design – Mixing and Dilution – Types of Combustion Chambers.	**10**
II.	**Centrifugal Compressors:** Essential Parts – Idea Energy Transfer – Velocity Tringles – Blade Shapes and their analysis – Diffuser – Volute Casing – Losses – Surging and Choking – multi spool axial compressor and turbofan **Axial Flow Compressors:** Geometry and Working Principle – Stage velocity – Compressor Stage Efficiency – Losses – Degree of Reaction – Performance Characteristics – Stalling, surging and choking	**10**
III.	**Axial and Radial flow turbines** Introduction - Turbine stage – Velocity Triangle - Work Done -Degree of Reaction - Losses – Efficiency - Multi-staging of Turbine - Turbine cooling methods - Turbine Cooling Technology - Radial Turbine Aerodynamics and Thermodynamics.	**10**
IV.	**Jet Propulsion and Rocket Propulsion:** Ramjet Engine – Pulse Jet Engine – Turboprop Engine – Turbojet Engine – Thrust Equations and its applications – Efficiencies – Classifications of Rockets – Principle of Rocket Propulsion – Optimum Expression Ratio for Rocket. **Environmental Considerations:** Air Pollution – N0x Formation and Reduction - Noise and Noise Reduction.	**10**
Total		**40**

Text Books:

1. V Ganesan, "Gas Turbine", McGraw – Hill Education Private Limited, 3rd Edition, 2017
2. Zucrow-Wiley, "Aircraft & Missile propulsion",New York-1958

Reference Books:

1. A. H. Shapiro, "Compressible fluid flow", The Ronald Press, New York-2002
2. S. M.Yahya, "Fundamentals of compressible flow with aircraft and rocket propulsion", New Age International (P) Ltd.-2007
3. Liepman & Roshko, "Elements of gas dynamics", Wiley, NewYork-1957
4. M.J. Zucrow & Joe D.Holfman, "Gas dynamics", Krieger Pub. Co.-1985

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VI**
Paper III (Elective I) / Subject Name: Instrumentation & Control		
		Subject Code: MEE022D6032
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To introduce the basic knowledge about measurement systems and their components • To provide understanding about various sensors used for measurement of mechanical quantities • To provide knowledge about system stability and control • To show the integration of the measurement systems with the process for process monitoring and Control	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • understand the measurement of various quantities using instruments, their accuracy & range, and the techniques for controlling devices automatically.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Measurement systems and performance – accuracy, range, resolution, error sources; Instrumentation & system engineer – sensor, transducer, potentiometer, dynamometer, accelerometer, LVDT, Kestler gauge, loadcell, LED as sensor, Hall effect sensor, strain gauge, Fast Fourier transform, wavelet transform Signal processing and conditioning; correction elements- actuators: pneumatic, hydraulic, electric, DAC & ADC, Basics of data acquisitionsystem	**10**

II.	Control systems – basic elements, open/closed loop, design of block diagram; control method – P, PI, PID, when to choose what, tuning of controllers, state space model, Root locus method	**10**
III.	System models, transfer function and system response, frequency response; Nyquist diagrams and their use - Kalman filter, Zegler & Nicole plot, Routh Herwitz criterion	**10**
IV.	Practical group-based project utilizing above concepts – Simulink & MatLab	**10**
Total		**40**

Text Books:

1. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 2005

Reference Books:

1. Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard V, Mechanical Measurements (6th Edition) 6th Edition, Pearson Education India, 2007
2. Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, McGraw-Hill: New York,1999.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VI**
Paper IV (Elective II) / Subject Name: Fluid Machines		**Subject Code: MEE022D6041**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To enable the students to know the operation of fluid machines. • To provide students thorough understanding of velocity triangles, thermodynamic plots and losses in turbo-machinery • To introduce students to turbines, pumps etc.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Solve analytical problems in turbo-machines • Demonstrate the knowledge of working stages performance characteristics, governing and selection of turbo-machinery.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics/ Course content	Hours
I.	**Hydraulic Turbines** Introduction: Classification of Fluid Machines, Impulse momentum equation, Impact of jet: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat & curve), effect of inclination of jet withthe surface. Hydraulic Turbines: Classification of turbines, Impulse turbines, constructional details, velocity triangles, power and efficiency calculations, governing of Pelton wheel.	**10**
II.	**Reaction Turbines:** Francis and Kaplan turbines, constructional details, velocity triangles, power and efficiency calculations, draft tube, cavitation in turbines, principles of similarity, unit and specific speed, performance characteristics, selection of water turbines	**10**

III.	**Centrifugal Pumps**: Classifications of centrifugal pumps, vector diagram, work done by impellor, efficiencies of centrifugal pumps, specific speed, cavitation, performance characteristics. **Reciprocating pump:** Positive Displacement Pumps: Reciprocating pump theory, slip and coefficient of discharges, indicator diagram, effect of acceleration, work saved by fitting air vessels, performance	**10**
IV.	**Fans and Blowers** Centrifugal Fans - Blowers Details - Inducers- Backward and Radial Blades. Axial flow fans. Fan laws **Fluid systems:** Hydraulic accumulator, Intensifier, Hydraulic press, theory of hydraulic coupling and torque converters, Water Lifting Devices: Hydraulic ram, Jet pumps, Airlift pumps, Gear and Vane pumps.	**10**
Total		**40**

Text Books:

1. C.S.P. Ojha, R. Berndtsson, "Fluid Mechanics and Machinery", Oxford University Press 4th edition 2012
2. R.K. Bansal, “Fluid Mechanics and Hydraulic Machines”, Laxmi Publications; Tenth edition, 2018

Reference Books:

1. Yahya.S.M., "Turbine, Fan and Compressors",TMH,2002.
2. Terry Wright, Philip Gerhart, “Fluid Machinery: Application, Selection, and Design”, CRC Press, 2019

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VI**
Paper IV (Elective II) / Subject Name: Mechatronic Systems		**Subject Code: MEE022D6042**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: TP**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To demonstrate an understanding of the key components of mechatronics systems, i.e. sensors, signal conditioning, displays, actuators, control systems/system response, and microcontrollers; • To demonstrate the ability to carry out design and prototyping of simple mechatronics systems.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • get an overview of mechatronics applications and the use of micro-sensors and microprocessors.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Prerequisites:

- Knowledge of Engineering Physics

Detailed Syllabus:

Modules	Topics/ Course content	Hours
I.	**Introduction to Mechatronics –** Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Binary Number System. Modelling and design, Mechatronic design quotient. Pneumatic and hydraulic systems; **Mechanical systems;** Electrical systems. Mathematical models; System building blocks; Engineering systems; Rotational-translational systems; Electromechanical systems; Hydraulic-mechanical systems Dynamic response;	**10**

II.	**Signal Conditioning:** The operational amplifier; Setting up basic simulations for sensing and control using op amps, Wheatstone bridge;Digital signals; D to A; A to D; Multiplexing. Filtering Noise using passive components – Registors, capacitors – Amplifying signals using OP amps– Signal Processing – Low pass , high pass , notch filtering	**10**
III.	**Sensors , Transducers –** Terminology; Different types of sensors – e.g. position, velocity, force, pressure, temperature etc.; Interfacing Sensors and Data Display Systems Practical examples of interfacing sensors and display systems with the Arduino; switches; thermistors; LDRs; ultrasonic sensors; LEDs; 7-segment displays; matrix displays **Actuators-** stepper motors, Servo motors, Hydraulic actuators. Interfacing and control of DC motors, stepper motors and servos using the Arduino Role of computer-aided design in mechatronics.	**10**
IV.	**System transfer functions;** Frequency response techniques- Bode plot, Nyquist diagram, Ziegler and Nicols tuning of P,I,D, PI,ID, PID controllers, root locus method, State space controller design, Kalman filter. **Microcontrollers:** Microcontroller architecture; Introduction to the Arduino; Overview of the Arduino IDE; Simple I/O examples ,Applications of microcontrollers. **Continuous and discrete processes;** Control modes; Different types of control, Formative exercise to design a simple mechanical system.	**10**
Total		**40**

Text Books:

1. Clarence D Silva, "Mechatronics : A foundation course", CRC Press,1st Edition, 2010
2. Bolton W., "Mechatronics, Electronic Control Systems in Mechanical and Electrical Engineering", 6th Edition, Pearson, UK

Reference Books:

1. Michael B.Histand and Davis G.Alciatore, "Introduction to Mechatronics and Measurement systems", McGraw Hill International edition, 2007.
2. Bradley D.A, Dawson D, Buru N.C and Loader A.J, "Mechatronics", Chapman and Hall, 1993.
3. Smaili.A and Mrad.F , "Mechatronics Integrated Technologies for Intelligent Machines", Oxford University Press, 2007.
4. Devadas Shetty and Richard A. Kolk, "Mechatronics Systems Design", PWS publishing company, 2007.
5. Krishna Kant, "Microprocessors & Microcontrollers", Prentice Hall of India, 2007.
6. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VI**
Paper V / Subject Name: Economics and Accountancy		**Subject Code: COM022A605**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To provide knowledge of the nature and scope of economics. • To perform financial analysis by accountancy.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Understand the various forms economic variables. The Demand, Supply, Production, Cost, Market Structure, Pricing aspects are learnt. The Students can study the firm's financial position by analyzing the Financial Statements of a Company.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	**Introduction to Economics:** Nature and Scope of Economics; Concepts of micro and macroeconomics, economic good and free good. **Demand and Supply Analysis** Law of Demand and determinants of demand; Categories and Types of Elasticity of Demand- price elasticity, income elasticity, cross elasticity; The determinants of elasticity, Demand elasticity and Revenue; Law of Supply and Elasticity of Supply.	**10**
II.	**The Theory of Production and Cost** Iso-quant and Iso-cost line; Law of Return to Scale and Law of Variable Proportion; Types of Cost – total, average and marginal cost, fixed cost & variable cost, long run and short run cost, private & social cost, economist's cost & accountant's cost, opportunity cost. **Market** Features of perfect competition and monopoly; Price-Output determination under-- perfect competition, simple problems of perfect competition.	**10**
III.	**Concepts of Accountancy** Various concepts like Journal, ledger and preparation of trial balance **Preparation of Final Account** Trading Account, Profit and Loss account, Balance Sheet.	**12**

IV.	**Depreciation:** Depreciation Policy, Causes of Depreciation, straight line method. **Cash Book:** Single, Double and Triple Column.	**8**
Total		**40**

Text Books:

1. D. D. Chaturvedi, S. L. Gupta, *Business Economics – Theory and Applications*, International Book House Pvt. Ltd. 2013.
2. Dhanesh K Khatri, *Financial Accounting*, Tata McGraw Hill, 2011.
3. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, *Managerial Economics*, 2e, Tata McGraw Hill Education Pvt. Ltd. 2012.

Reference Books:

1. Paresh Shah, *Financial Accounting for Management* 2e, Oxford Press, 2015.
2. S. N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, *Financial Accounting*, 5e, Vikas Publications, 2013.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VI**
Paper VI / Subject Name: Dynamics of Machines Lab		**Subject Code: MEE022C611**
L-T-P-C – 0-0-2-1	**Credit Units: 01**	**Scheme of Evaluation: P**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To understand the force-motion relationship in components subjected to External Forces. • To analyse the force-motion characteristics of standard mechanisms	1. Demonstration 2. Lab Experiment 3. Quiz 4. Viva-Voce	On successful completion the student will be able to: • Analyse the behaviour of bodies undergoing vibrations, both theoretically as well as practically. • Analyse and interpret data across all practical.	• Continuous Evaluation: 25% (Skill Test, lab copy, viva, lab involvement: Any Three) • Attendance: 5% • End term examination: 70 %

Detailed Syllabus:

Experiment No	Aim of the Experiment	Hours
1.	To Study the undamped free vibration of spring mass system	03
2.	To study the forced vibration of spring mass system	03
3.	To find the natural frequencies of a two rotor system.	03
4.	To study the whirling phenomenon of shaft.	03
5.	To study the cam analysis by graphical method	03
Total		**15**

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VI**
Paper VII / Subject Name: Effective Workspace Communication		
		Subject Code: CEN982A601
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To introduce students to areas of concern in the workplace environment like culture, business etiquettes, decision making, and workplace interpersonal relationships	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Demonstrate conscious efforts to build stronger interpersonal relationships with co-workers in the workplace. • Understand corporate culture and the expected behavior from an employee. • Develop knowledgeof responsible etiquettes thus making them readyfor the professional life ahead.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Prerequisites: Basic knowledge of interpersonal communication and organizational communication paradigms.

Detailed Syllabus:

Modules	Topics	Course Contents	Hours
I	**Communicating Across Cultures in a Diverse Work Environment**	What is Culture, Workplace culture, Communicating across different cultures, Culture and writing skills, Culture and non-verbal communication, Managing Global Teams. Cross cultural communication (view of authority – Egalitarian versus Hierarchy and status; view of society – individualist or collectivist society teamwork versus individualism; view of time – linear and flexible punctuality, technology; cultural contexts, international communication, high and low context culture, intercultural communication and the workplace, cultural conflicts, resolving conflicts.	**3**
II	**Business Etiquette**	What is etiquette, Constituents of etiquette (First Impression, Dressing and Grooming etiquette, Conduct at the workplace, Body Language, Introducing yourself and others, Business Cards, Dining and Gifts, Meeting Customers and Clients, Travelling, Gender issues, Small talks etiquette, General business meeting etiquettes, Offline Networking etiquette)	**3**

		Business Etiquette and modern technology (emails, Instant Messaging, Text messages and Mobile Phones, Social Networking sites, , Using Software and Hardware, Audio/Videoconferencing)	
III	**Managing Relationship at Work**	Peer-to-peer relationship, peer-to-superior relationship, peer-to subordinate relationship, Communicating Effectively within your team, Gateways to effective interpersonal communication, conflicts in a team. Theories of Interpersonal and Organizational Communication. Classical Rhetoric, Contagion Theory, Enactment theory, Groupthink, Network theory, Media richness and media naturalness theory, Reduced social cues approach, Sense making, Uncertainty reduction theory.	**3**
IV	**Corporate Communication**	Organizational Decision Making tools – Brainstorming, Nominal Group Technique, Delphi Technique Why corporate communication, Focus areas of Corporate communication (Internal – employees, departments; External – reputation, corporate social responsible, government, financial communication, media, crisis communication)	**3**
TOTAL			**36**

Text Books:

1. *Business Communication: Essential Strategies for Twenty-first Century Managers,* Verma, Shalini, 2nd Edition, Vikas Publishing House Pvt. Ltd, pp. 30-47, 100-116, 140-147, 155-159, 415-443.

Reference Books:

1. Mukherjee, Hory Sankar, *Business Communication: Connecting At Work*, 1st Edition, 2013, Oxford University Press, pp. 530 – 543, 501-528

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VI**
Paper VIII / Subject Name: Essence of Indian Traditional Knowledge		
		Subject Code: ILD992S603
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Course Objective	*Teaching Learning Process*	*Learning Outcomes*	*Course Evaluation*
The objectives of the course are:- • To get a knowledge in Indian Culture • To Know Indian Languages and Literature and the fine arts in India • To explore the Science and Scientists of Medieval and Modern India	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Understand philosophy of Indian culture. • Distinguish the Indian languages and literature. • Learn the philosophy of ancient, medieval and modern India. • Acquire the information about the fine arts in India. • Know the contribution of scientists of different eras.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Introduction to Culture: Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India	**10**
II.	Indian Languages, Culture and Literature: Indian Languages and Literature-I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India ,Indian Languages and Literature-II: Northern Indian languages & literature	**10**
III.	Religion and Philosophy: Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)	**10**

IV.	Education System in India: Education in ancient, medieval and modern India, aims of education, Subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India	**10**
Total		**40**

Text Books:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition",ISBN: 81246033375,
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2000
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450 494-X, 200
4. S. Narain, "Examinations in ancient India", Arya Book Depot, 1993

Reference Books:

1. SatyaPrakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 198
2. M. Hiriyanna, "Essentials of Indian Philosophy", MotilalBanarsidassPublishers, ISBN 13: 978-8120810990, 2014

Course: Open	**SYLLABUS**	**Semester: VI**
Paper IX (Open Elective II) / Subject Name: Fundamentals of Automobile Engineering		
		Subject Code: MEE022G6091
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	*Teaching Learning Process*	*Learning Outcomes*	*Course Evaluation*
The objectives of the course are:- • To develop conceptof automotive structural design. • To provide understanding of the mechanics of vehicle. • To provide knowledge of the working principle of designs of automotive sub assemblies and components. • To develop the concepts of automotive performance evaluation and testing.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Clear fundamentals of automobile design to undertake specialist course in automotive design. • understand the design and functioning of various automotive components. • develop specifications of a vehicles, performance evaluation and testing.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics/ Course content	Hours
I.	Automotives types- wheeled and tracked vehicles; Basics of tracked vehicles; Hybrid vehicles fundamentals. Automotive performance evaluation and testing. Vehicle chassis frame- type and applications; Vehicle wheel types and geometry – camber, caster, king pin inclination, toe in and toe out, Tyre stiffness and basics of wheel/track and soil interaction(terra-mechanics);	**10**

II.	Suspension system- Dependent suspension - Hotchkiss drive , torque tube suspension, semi dependent suspension and independent suspension, camber recovery feature, Human response to vibration – fatigue decreased proficiency curves, Shock absorber design. Steering system- steering and handling, oversteer, understeer and neutral steer condition correlation to slip angles, steering mechanism types (Davis and Ackerman), critical speed, power steering.	**10**
III.	Drivetrain design- SI/CI engines selection for various applications; Turbocharging- Miller turbocharging and hyper bar turbocharging. Down speeding and downsizing of SI engines, Electrical accessories, starting system and ignition system Injection system for CI and SI engine.	**10**
IV.	Differential mechanism, Gear box design- sliding mech, constant mesh and synchromesh, Gradability, Tractive effort and draw bar pull calculation and gear ratio design, automatic transmission system. Brakes: Disc and Drum brakes, braking distance.	**10**
Total		**40**

Text Books:

(1) K Newton, W Steeds, G K Garrett, (1998), The Motor Vehicle, Butterworth Hienemann.
(2) G Genta, Morello L, F Cavalino, L Fliri,(2014) The Motor Car- Present Past and Future, Springer, 1/e
(3) J Y Wong, (1993), Theory of Ground Vehicles, John Wiley and Sons(2/e).

Course: Open	**SYLLABUS**	**Semester: VI**
Paper IX (Open Elective II) / Subject Name: 3D Modelling & Printing		
		Subject Code: MEE022G6092
L-T-P-C – 2-0-2-3	**Credit Units: 03**	**Scheme of Evaluation: TP**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To provide knowledge of integrating several design processes together; allowing more creative room and to develop easily shareable designs	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Improving engineers' inspection capabilities and enhancing quality assurance, thereby increasing efficiency and optimizing resources. • Identifying problems earlier. • Making greater team collaboration possible.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	**2D Modelling:** 2D Modelling using AutoCAD – Page setting – Drawing Tools - Modifying tools – Dimensioning – Printing. Importing 2D drawings in other software. 2D Image processing of different file format using Photoshop.	**10**
II.	**3D Modelling:** Types of projections - Isometric Projection and Introduction to Autodesk Fusion 360 and modelling of products - 3D Modelling using AutoCAD, 3D Max and CATIA – Importing different files – Drawing tools – Modifying tools – Surface modelling etc.	**10**
III.	**Rendering:** Different Lighting methods - Different lighting conditions - Mental Ray rendering – Types of Camera and its uses.	**10**
IV.	**3D Printing:** Introduction to 3D printing - concepts - Types and the versatility of the machine - operation. Overview on 3D Machine and its parts - Making of component and assembly of product - Sculpture modelling - Introduction to 3D printing tools (Infill, Shell, support, etc.) - Use of Cura and implement printing tools with specific values - Printing of 3D products - post-Processing	**10**
Total		**40**

Text Books:

1. William Vaughan, “William Vaughan”, New Readers.
2. Ben Redwood, “The 3D Printing Handbook: Technologies, Design And Applications”

Reference Books:

1. Liza Wallach Kloski,“Getting Started with 3D Printing” Maker Media, Inc.
2. Matt Chandler, “3ds Max Projects: A Detailed Guide to Modeling, Texturing, Rigging, Animation and Lighting”

ROYAL SCHOOL OF ENGINEERING & TECHNOLOGY
B.TECH. IN MECHANICAL ENGINEERING
COURSE STRUCTURE

7th semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MEE022C701	Finite Element Method	3	1	0	4	4
2	MEE022C702	Manufacturing Methods	3	0	0	3	3
3	MEE022D703X	Elective III (Departmental)	3	0	0	3	3
4	MEE022D704X	Elective IV (Departmental)	3	0	0	3	3
5	xxx02xG7xxx	Open Elective III (from within the school)	3	0	0	3	3
6	MEE022C726	Project I	0	0	8	4	8
7	MEE022C747	Assessment of the Summer Training	0	0	0	2	0
		TOTAL	**15**	**1**	**8**	**22**	**24**

MEE022D703X	**Elective III**	**L**	**T**	**P**	**C**
MEE022D7031	Project & Production Management	3	0	0	3
MEE022D7032	Total Quality Management	3	0	0	3

MEE022D704X	**Elective IV**	**L**	**T**	**P**	**C**
MEE022D7041	Automobile Engineering	3	0	0	3
MEE022D7042	Design of Transmission Systems	3	0	0	3

MEE022G705X	**Open Elective III**	**L**	**T**	**P**	**C**
MEE022G7051	Operation Research	3	0	0	3
MEE022G7052	Composite Materials	3	0	0	3

Approved by:

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VII**
Paper I / Subject Name: Finite Element Method		**Subject Code: MEE022C701**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

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Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To provide understanding of the general steps of finite element method. • To introduce the basic finite element formulation techniques. • To derive the equations for 1D and 2D problems. • To formulate and solve basic problems in heat transfer, solid mechanics and fluid mechanics. • To derive the shape functions in terms of natural coordinates • To solve any problems by any FE software such as ANSYS or be able to develop a code by their own.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Be able to apply the strength of material concept to solve the FEM problem. • Be able to derive the finite element formulation for application of 1D and 2D problems. • Be able to develop an algorithm for FE formulation. • Participate or lead projects in mechanical system design, product development, modelling and analysis of mechanical systems, materials technology, production technology, structural mechanics and design of lightweight structures.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Prerequisites:

- Basics of Strength of materials, DOM, Fluid Mechanics, Concept of calculus of variation.

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	**Finite Element Discretization,Direct stiffness methods and FE approximation methods** Basic concept of structural modelling, Introduction to FE modelling, Solving Axial rod and bending of beams by direct stiffness method – Pre-processing, solving, Post processing. Extensions to plane truss problems. Variational form – principle potential energy, Galerkin, RITZ, Least square method, collocation method	**10**
II.	**1D & 2D Finite element formulation, Numerical Integration** Finite element formulation-completeness, compatibility, shape functions for c^0 and c^1 element, RITZ method, Galerkin method for axial rod problem, Steady state heat conduction problem, heat conduction in polar coordinates and fluid problems. Introduction to types of 2D element, triangular element, tetrahedral element, brick element and rectangular element, pascal's triangle, CST element- 3 node , 6 node and 10 node. Fluid flow problem. Introduction to quadrature, One Dimensional Integration Formulae - Gauss Quadrature – 2 point and 3 point.	**12**
III.	**2D FEM : Detailed Discussion** Introduction- Natural Coordinates and Iso-Parametric, Sub-Parametric and Super-Parametric Elements, Four-Noded Quadrilateral Elements, Serendipity Elements, Eight-Noded Curvilinear Elements.	**8**
IV.	**Finite Element Formulations:** Finite element formulation for plane stress and plane strain problems, vibrations of a rod, vibrations of a beam, Thin plate formulation, Thick-plate formulation. Time history problems. Solving FEM Problems on a Computer: FEM Package – ANSYS, MATLAB.	**10**
Total		**40**

Text Books:

1. U.S Dixit, "*Finite Element Methods for Engineers*". Cengage Learning; 1st edition, 2009
2. R.D. Cook, D.S. Malkus and M.E. Plesha, "Concepts and Applications of Finite Element Analysis", Wiley; Fourth edition (2007)

Reference Books:

1. T.R. Chandrupatla and A.D. Belegundu, "Introduction to Finite Elements in Engineering:, Prentice Hall of India.
2. J.N. Reddy, "An Introduction to the Finite Element Method", McGraw-Hill.
3. S. S. Rao, "Finite Element Analysis", Elsevier Butterworth-Heinemann

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VII**
Paper II / Subject Name: Manufacturing Methods		**Subject Code: MEE022C702**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	*Teaching Learning Process*	*Learning Outcomes*	*Course Evaluation*
The objectives of the course are:- • The course will enable the students to acquire a fundamental knowledge on metal forming technology which is necessary for an understanding of industrial processes. • To introduce students to the wide range of materials and processes, which are currently used in manufacturing industry. • The course will also provide methods of analysis allowing a mathematical/physical description of forming processes. • The course will enable the students to identify the processes characteristics, select the main operator parameters, the tool geometry and materials, and determine forces and power required to select the main and auxiliary equipment.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • The student will be having the capability of selecting suitable manufacturing processes to manufacture the products optimally. • The student will be able to recommend the appropriate design of gating systems, forming processes, welding process and NDT technique. • The student will be able to develop simplified manufacturing processes with the aim of reduction of cost and manpower. • The student will be able to identify/control the appropriate process parameters, and possible defects of manufacturing processes so as to remove them.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	**Forging and rolling processes**. Forging principle, classification, equipment, tooling-processes, parameters and calculation of forces and power requirements during forging post forging heat treatment - defects (cause and remedy) & application; Principles of rolling processes, classification, types of rolling mills, ring comparison tests calculation of forces and geometrical relationship in rolling, analysis of rolling load, torque and power, rolling mill control, effects of friction. Form rolling, rolling defects, causes and remedies	**10**
II.	**Extrusion and Drawing Processes**. Classification of extrusion processes-tool, equipment, and principle of these processes, influence on friction-Extrusion force calculation-defects and analysis-rod/wire drawing-tool, equipment and principle of processes defects-Tube drawing and sinking processes-Mannessmann processes of seamless pipe manufacturing.	**10**
III.	**Sheet metal forming processes** Classification - conventional and HERF processes-presses-types and selection of presses formability of sheet metals- principle, process parameters, equipment and application of the following processes: deep drawing, spinning, stretch forming. Plate bending, spring back, press brake forming, Introduction to forming, electro hydraulic forming, magnetic pulse forming. Introduction to press work – coining, embossing etc., Design of sheet metal dies.	**10**
IV.	**Powder Metallurgy** Introduction to Powder Metallurgy process, preparation of powders, types & function of binders, green compaction, sintering process and its effect on the product, application of powder metallurgy products, advantages of powder metallurgy products. Sintering equipment. Clutch and braking system- anti lock braking system, proportionate braking system **Surface Finishing Operations:** Introduction – Classification – Principle and Operations of Lapping, Honing, Super finishing, Polishing, Buffing, Tumbling and Burnishing	**10**
Total		**40**

Text Books:

1. Serope Kalpakjian, Steven R. Schmid "Manufacturing Engineering and Technology" (4th Edition) Prentice Hall 2000
2. P.N.Rao "Manufacturing Technology", TMH Ltd 1998(Revised edition)
3. Dieter "Mechanical Metallurgy", Revised edition 1992, Mcgraw Hill

Reference Books:

1. 1 E. Paul DeGarmo, J. T. Black, Ronald A. Kohser, "Materials and Processes in Manufacturing", Wiley; 9 edition (December 6, 2002)
2. Lindberg, "Processes and Materials of Manufacture ", Prentice Hall of India (p) Ltd

3. George.E. Dieter, “Engineering design (A materials and processing approach)”, McGraw Hill Edition II 1991
4. William F.Hosford & Robert M.Caddel “Metal forming”
5. Amitabha Ghosh and Mallik, “Manufacturing Science”, East west press pvt ltd
6. Narayanaswamy. R, “Metal Working Technology”, PHI (1997)
7. Nagpal. G.R., ”Metal Forming Processes” Khanna publishers, Delhi 1998
8. Sinha and Prasad, “Theory of Metal Forming and Metal Cutting”, Dhanpat Rai Publication 1999

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VII**
Paper III / Core Elective III		
Subject Name: Project & Production Management		**Subject Code: MEE022D7031**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To enable the students to have overall view of project management techniques. • To introduce students to project definition, management techniques, planning and scheduling. • To teach students the commercial aspects of projects.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Demonstrate the core philosophy of project management. • Possess the knowledge of project management techniques. • Exposed to commercial and legal aspects of projects.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics/ Course content	Hours
I.	Introduction to Project Management – definition of project, characteristics of project, definition of Project management, characteristics of PM, dimension of project goals, types of project manager, Market and demand analysis	**10**
II.	System concept of production, Product Design, Product Mix, Product life cycle, Productivity, Management decisions-strategic, tactical and operational, Forecasting, forecasting techniques, moving average, simple exponential smoothing linear regression, Technological forecasting	**10**
III.	Production Planning and Control-meaning and objectives, Steps in PPC, Job, Batch and Flow Production Methods. Process Planning Routing, Scheduling "of flow shop and job shop productions, Production Control-Monitoring, Expediting and Re-planning, Material Requirement and Planning MRP, Master Production Schedule MPS, MRP-II, Bill of Materials, MRP Calculations.	**10**

IV.	Features and objectives of Project, Classification and selection of Project, Project Life Cycle and Planning, Project Scheduling, Controlling and Monitoring, Payback period Calculations Basic PERT/CPM Calculations, Crashing of network, AOA and AON, Precedence diagram, Gantt chart, limitations of PERT and CPM, GERT.	**10**
Total		**40**

Text Books:

1. Clifford F. Gray, Erik W. Larson, Gawtam V. Desai,"Project Management - The Managerial Process ".6th Edition

Reference Books:

1. Jeffrey K. Pinto, Peter W. G. Morris, Pinto Morris."The Wiley Guide to Project, Program & Portfolio Management."

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VII**
Paper III / Core Elective III		
Subject Name: Total Quality Management		**Subject Code: MEE022D7032**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To enable the students to understand the principles of Quality Management • To provide students details of Quality Planning and TQM techniques. • To provide in-depth knowledge of reliability and maintainability.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Implement TQM in industries • Possess the knowledge of quality planning and TQM techniques. • Design systems with reliability and maintainability.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics/ Course content	Hours
I.	Quality definition, characteristics, dimensions of quality, quality cost, categories of quality, quality characteristics, variation, variables, attributes, Inspection & sampling.	**10**
II.	Control chart-variable control charts, on line & off line qualiy sytem , Process capability analysis,	**10**
III.	Deming's 14 point philosophy, cause and effect diagram, Pareto principle, procedure for construction of Pareto principle	**10**
IV.	TQM – definition, objective, Concepts of the TQM philosophy, Quality Tools, 7 pillars of TQM, quantification of quality Concept of internal customer and External Customer, & Internal supplier. TPM, goals of TPM, pillars of TPM, 5s principle, types of maintenance	**10**
Total		**40**

Text Books:

1. Dale H Besterfield,(2008), Total Quality Management,Pearson Education**.**

Reference Books:

1. Joel E.Rose,(1993)Total Quality Management,II Edition, Kogan Page Ltd.,USA.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VII**
Paper IV / Core Elective IV		
Subject Name: Automobile Engineering		**Subject Code: MEE022D7041**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	*Teaching Learning Process*	*Learning Outcomes*	*Course Evaluation*
The objectives of the course are:- • Develop concept of automotive design. • Understanding the mechanics of vehicle. • Understanding the working principles of designs of automotive sub-assemblies and components. • Develop the concepts of automotive performance evaluation and testing.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • The students develop clear fundamentals of automobile design to undertake specialist course in automotive design. • The course shall enable the student to understand the design and functioning of various automotive components. • The course renders adequate fundamentals to develop specifications of a vehicles, performance evaluation and testing.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Automotive types- wheeled and tracked vehicles; Vehicle chassis frame- type and applications; Vehicle wheel geometry – camber, caster, king pin inclination, toe in and toe out. Basics of tracked vehicles; Tyre stiffness and basics of wheel/track and soil interaction (terra-mechanics); Electrical accessories and ignition system, injection system and MPFI system for SI engines.	**10**

II.	Driveline design- SI/CI engines performance evaluation and selection for various applications; Turbocharging- Down-speeding and downsizing of SI engines, Miller turbocharging and hyper bar turbocharging.	**10**
III.	Steering system- steering and handling, oversteer, understeer and neutral steer condition correlation to slip angles, Ackermann principles and Davis steering, critical speed, steering mechanism types. Suspension system- Dependent suspension - Hotchkiss drive, torque tube suspension, semi dependent suspension and independent suspension, camber recovery feature. Human response to vibration – fatigue decreased proficiency curves. Shock absorber design.	**10**
IV.	Differential mechanism, Gear box design- sliding mech, constant mesh and synchromesh, Gradeability, Tractive effort and draw bar pull calculation and gear ratio design, automatic transmission system. Automotive performance evaluation and testing. Hybrid vehicles fundamentals. Clutch and braking system- anti lock braking system, proportionate braking system	**10**
Total		**40**

Text Books:

(1) K Newton, W Steeds, G K Garrett, (1998), The Motor Vehicle, Butterworth Heinemann.
(2) G Genta, Morello L, F Cavalino, L Fliri, (2014) The Motor Car- Present Past and Future, Springer, 1/e
(3) J Y Wong, (1993), Theory of Ground Vehicles, John Wiley and Sons(2/e).

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VII**
Paper IV / Core Elective IV		
Subject Name: Design of Transmission Systems		**Subject Code: MEE022D7042**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To learn about the design procedures for mechanical power transmission components.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • To design transmission systems for engines and machines.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears.	**10**
II.	Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears.	**10**
III.	Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-seed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications.	**10**

IV.	Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake.	**10**
Total		**40**

Text Books:

1. Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010.
2. Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.
3. Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001.

Course: B.Tech. (M.E)	SYLLABUS	Semester: VII
Paper V / Open Elective III		
Subject Name: Operation Research		Subject Code: MEE022G7051
L-T-P-C – 3-0-0-3	Credit Units: 03	Scheme of Evaluation: T

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To provide knowledge of the importance of OR in managing scarce resources • To familiarize the different Optimization Techniques	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • To appreciate the fact that resources would always be scarce and that should be utilized the best to get desired outcome in life. • Learn different Optimization Techniques that are used in real life applications.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Introduction to OR; Engineering Applications; Formulation of Optimization Problems; Types of OR problems – LPP, IPP, NLP. Linear Programming Problem – Basic definitions related to LPP; Feasibility & Optimality; Graphical Method for solving LPP; Simplex algorithm; Big – M method; 2 – phase method; Dual Simplex algorithm; Unbounded solution; Degeneracy and Cycling	10
II.	Formulation and solution of – Integer Programming Problem, Transportation Problem, Assignment Problem, Travelling Salesman Problem	10
III.	Non-Linear Programming – Single and multi variate problems; Lagrangean method; KKT method	10
IV.	Inventory; Classification of Inventory; Economic Order Quantity; Queueing Theory; Markov Chains	10
Total		40

Text Books:

1. Frederick S. Hillier, Gerald J. Lieberman, Bodhibrata Nag, Preetam Basu, *Introduction to Operations Research*, Ninth Edition, Special Indian Edition, McGraw Hill Education (India), 2012

Reference Books:

1. P K Gupta. D S Hira, *Introduction to Operations Research*, S. Chand, Seventh Edition, S. Chand Publication

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VII**
Paper V / Open Elective III		
Subject Name: Composite Materials		**Subject Code: MEE022G7052**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	*Teaching Learning Process*	*Learning Outcomes*	*Course Evaluation*
The objectives of the course are:- • In this course the students will learn about the benefits gained when combining different materials into a composite. • The motive ts to make the students to understand different processing methods, issues, properties and testing methods of different composite materials	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Use of different material to design composites • Use of different techniques to process different types of Composites and know the limitations of each process	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	INTRODUCTION TO COMPOSITES Fundamentals of Composites – Need for Composites – Enhancement of Properties – Classification of Composites – Matrix-Polymer Matrix Composites (PMC), Metal Matrix Composites (MMC), Ceramic Matrix Composites (CMC) – Reinforcement – Particle Reinforced Composites, Fibre Reinforced Composites. Applications of Various Types of Composites. Fiber Production Techniques for Glass, Carbon and Ceramic Fibers	**10**
II.	POLYMER MATRIX COMPOSITES Polymer Resins – Thermosetting Resins, Thermoplastic Resins – Reinforcement Fibres – Rovings – Woven Fabrics – Non-Woven Random Mats – Various Types of Fibres. PMC Processes – Hand Lay Up Processes – Spray Up Processes – Compression Moulding – Reinforced Reaction Injection Moulding – Resin Transfer Moulding – Pultrusion – Filament Winding – Injection Moulding. Fibre Reinforced Plastics (FRP), Glass Fibre Reinforced Plastics (GFRP).	**10**

	Laminates- Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. -Applications Of PMC In Aerospace, Automotive Industries	
III.	METAL MATRIX COMPOSITES Characteristics Of MMC, Various Types of Metal Matrix Composites Alloy Vs. MMC, Advantages Of MMC, Limitations Of MMC, Reinforcements – Particles – Fibres. Effect of Reinforcement – Volume Fraction – Rule Of Mixtures. Processing of MMC – Powder Metallurgy Process – Diffusion Bonding – Stir Casting – Squeeze Casting, A Spray Process, Liquid Infiltration In-Situ Reactions-Interface-Measurement Of Interface Properties- Applications Of MMC In Aerospace, Automotive Industries	**10**
IV.	CERAMIC MATRIX COMPOSITES AND SPECIAL COMPOSITES Engineering Ceramic Materials – Properties – Advantages – Limitations – Monolithic Ceramics – Need for CMC – Ceramic Matrix – Various Types of Ceramic Matrix Composites- Oxide Ceramics – Non-Oxide Ceramics – Aluminium Oxide – Silicon Nitride – Reinforcements – Particles- Fibres- Whiskers. Sintering – Hot Pressing – Cold Isostatic Pressing (CIPing) – Hot Isostatic Pressing (HIPing). Applications of CMC In Aerospace, Automotive Industries-Carbon /Carbon Composites – Advantages of Carbon Matrix – Limitations of Carbon Matrix Carbon Fibre – Chemical Vapour Deposition of Carbon on Carbon Fibre Perform. Sol-Gel Technique-Processing of Ceramic Matrix Composites	**10**
Total		**40**

Text Books:

1. Mathews F. L. And Rawlings R. D., "Composite Materials: Engineering and Science", 1st Edition, Chapman and Hall, London, England, 1994.
2. Chawla K. K., "Composite Materials", Second Edition, Springer – Verlag, 1998.

Reference Books:

1. Clyne, T. W. And Withers, P. J., "Introduction to Metal Matrix Composites", Cambridge University Press, 1993.
2. Strong, A.B., "Fundamentals of Composite Manufacturing", SME, 1989.
3. Sharma, S.C., "Composite Materials", Narosa Publications, 2000.
4. Broutman, L.J. And Krock,R.M., " Modern Composite Materials", Addison-Wesley, 1967.
5. ASM Hand Book, "Composites", Vol.21, ASM International, 2001.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VII**
Paper VI / Subject Name: Project I		**Subject Code: MEE022C726**
L-T-P-C – 0-0-8-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Course Objective	*Teaching Learning Process*	*Learning Outcomes*	*Course Evaluation*
The objectives of the course are:- • To practice the steps involved for the selection, execution, and reporting of the project.	1. Individual and Group Presentation 2. Viva-Voce	On successful completion the student will be able to: • Identify real world problems of mechanical engineering and related systems. • Interpret the working of mechanical engineering systems. • Apply the principles of mechanical engineering in real world systems. • Criticize and experiment to arrive at solutions for real world mechanical engineering problems.	• End Term Examination: 100%

The project work shall be a theoretical/ experimental/ design/ software project on any of the topics of mechanical engineering interest. The work is to be done individually. The topic of the project should be different from his/her mini project. A faculty member will always be supervising each student as an internal guide. In case an industrial project is selected, in addition to the internal guide, there should be an external guide from the industry. During this semester, each student is required to select a topic for the project and study the feasibility. A project evaluation committee will be constituted by head of the department at the beginning of the semester. A brief report of the chosen project should be submitted before the committee within two weeks from the beginning of the VIIth semester. The committee will give permission for the project after examining the feasibility. In the event of rejection of the topic by the committee, the student should resubmit a new project topic within one week, and get it approved by the committee. After getting the permission, they have to conduct a detailed literature survey, and collect sufficient information and necessary data. Further, they have to a prepare an action plan to carry out the project in the next semester. At the end of thesemester, each student should prepare a preliminary report of the project, and appear before the committee for evaluation.

The assessment of the projects should be done at the end of the seventh semester by the committee. The committee will award marks-based performance.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VII**
Paper VII / Subject Name: Summer Training		**Subject Code: MEE022C747**
L-T-P-C – 0-0-0-2	**Credit Units: 02**	**Scheme of Evaluation: P**

Course Objective	*Teaching Learning Process*	*Learning Outcomes*	*Course Evaluation*
The objectives of the course are:- • To acquire industrial experience.	1. Individual and Group Presentation 2. Viva-Voce	On successful completion the student will be able to: • Acquire and apply fundamental principles of engineering. • Update with all the latest changes in technological world. • Identify, formulate and model problems and find engineering solution based on a systems approach.	• End Term Examination: 100%

The students need undertake minimum 3 weeks summer training in research institute/organization or industries at the end of the 6th semester. A report needs to besubmitted in the start of 7th semester. The students will have to give a presentation on the summer training undertaken during the 6th semester.

ROYAL SCHOOL OF ENGINEERING & TECHNOLOGY
B.TECH. IN MECHANICAL ENGINEERING
COURSE STRUCTURE

8th semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	MEE022C801	Refrigeration and Air Conditioning	3	0	0	3	3
2	MEE022D802X	Elective V (Departmental)	3	0	0	3	3
3	MEE022D803X	Elective VI (Departmental)	3	0	0	3	3
4	xxxxxxG8xxx	Open Elective IV (from within the school)	3	0	0	3	3
5	MEE022C824	Project - II	0	0	10	5	10
6	MEE022C836	Comprehensive Viva	0	0	0	2	0
		TOTAL	**12**	**0**	**10**	**19**	**22**

MEE022D802X	**Elective V**	**L**	**T**	**P**	**C**
MEE022D8021	Computational Fluid Dynamics & Heat Transfer	3	0	0	3
MEE022D8022	Fluid Power Control	3	0	0	3

MEE022D803X	**Elective VI**	**L**	**T**	**P**	**C**
MEE022D8031	Energy Conservation & Management	3	0	0	3
MEE022D8032	Metrology & Instrumentation	3	0	0	3

MEE022G804X	**Open Elective IV (Within School)**	**L**	**T**	**P**	**C**
MEE022G8041	Process Planning & Cost Estimation	3	0	0	3
MEE022G8042	Problem solving using MATLAB & Simulink	3	0	0	3

Approved by:

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VIII**
Paper I / Subject Name: Refrigeration and Air Conditioning		**Subject Code: MEE022C801**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • The course is designed to give fundamental knowledge of types of refrigeration, refrigeration cycles, refrigerants and behavior under various conditions, different air conditioning terms and load calculation and air conditioning systems.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Understand the basic concepts of refrigeration and air conditioning systems • Understand and analysis of various refrigeration cycles • Make basic calculation of psychometric properties and process • Do basic calculations of heating and cooling load requirements of a room. • Apply scientific and engineering principles to analyze and design aspects of engineering systems that relate to refrigeration and air conditioning.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Introduction: Brief history and need of refrigeration and air conditioning, methods of producing cooling, ton of refrigeration, coefficient of performance, types and application of refrigeration and air condensing systems. [3] Refrigerants: Classification, nomenclature, desirable properties and future industrial refrigerants [2]	**10**

	Air refrigeration: Reversed Carnot cycle and its limitation, Bell-Coleman cycle, aircraft refrigeration, working and analysis of Simple; Bootstrap; Reduced ambient and Regenerative air refrigeration systems [5]	
II.	Vapour Compression system: Simple system on P-h and T-s diagrams, analysis of the simple cycle, factors affecting the performance of the cycle, actual cycle [6] Absorption refrigeration system: Desirable characteristics of refrigerant, selection of pair, practical H_2O -NH_3 cycle, LiBr – H_2O system and its working and Electrolux refrigeration system. [4]	**10**
III.	Psychrometry: Dalton's law of partial pressure, Properties of moist air, temperature and humidity measuring instruments, psychrometric chart, psychrometric processes such as sensible heating and cooling, heating and humidification cooling and dehumidification, and adiabatic saturation [6] Human comfort and introduction to cooling load calculation. [4]	**10**
IV.	Refrigeration system components: Types; construction; working; comparison and selection of compressors; condensers; expansion devices; and evaporators, evacuation and charging of refrigerant [5] Basics of duct design: Function; classification, equal friction method of duct design, use of friction chart, dynamic losses and its determination. [3] Air-conditioning systems: Classification, system components, all air; all water; and air-water systems, room air conditioners, packaged air conditioning plant, central air conditioning systems, split air conditioning systems [2]	**10**
Total		**40**

Text Books:

1. Refrigeration and Air Conditioning by C P Arora, McGraw-Hill India Publishing Ltd.
2. Refrigeration and Air Conditioning by Manohar Prasad, New Age International Publisher

Reference Books:

1. Principles of Refrigeration by Roy. J Dossat, Pearson Education
2. Refrigeration and Air Conditioning by Jordon and Prister, Prentice Hall of India Pvt. Ltd.
3. Refrigeration and Air Conditioning by W.F. Stocker and J. W. Jones, McGraw-Hill
4. Refrigeration and Air Conditioning by Ameen Ahmadul, PHI India

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VIII**
Paper II / Core Elective V		
Subject Name: Computational Fluid Mechanics and Heat Transfer		**Subject Code: MEE022D8021**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • Simulation of fluid flows with heat and mass transfer in various engineering and natural objects. • Designing of these devices for the required operational parameters is impossible without reliable prediction of characteristics of these flows. • CFD plays a vital role in modeling and design optimization of modern engineering devices. The course is designed to cover the essentials of CFD with application.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Understand solution of aerodynamic flows. Appraise & compare current CFD software. Simplify flow problems and solve them exactly • Define and setup flow problem properly within CFD context, performing solid modelling using CAD package and producing grids via meshing tool • Understand both flow physics and mathematical properties of governing Navier-Stokes equations and define proper boundary conditions for solution • Use CFD software to model relevant engineering flow problems. Analyze the CFD results. Compare with available data, and discuss the findings	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	**The Equations of Fluid Dynamics:** General form of a Conservation law: equation of mass conservation, conservation law of momentum, conservation equation of energy. The Navier-Stoke's equation, Reynold's Averaged NS equation, Boundary Layer Approximations, The distributed loss model, The inviscid flow model, Euler equations, steady inviscid rotational flow, The potential flow model. Non-dimensionalization of Continuity, NS and Energy equations and its applications.	**10**
II.	**Basic discretization techniques:** Types of Partial Differential Equations and its applications, Truncation Error analysis, Consistency, Stability, Convergence. The finite difference method: Conversion of PDE to FDE using Taylors Series and 3-Point Method. The finite volume method and conservative discretization: Integral Method - Meshing and Grid Generation	**10**
III.	Solutions of Poisson's and Laplace equation- FTCS method- FTFS method etc. Solution of 1D Heat conduction equation – Simple explicit method – ADI method – DuFort-Frankel method – Crank Nicolson method etc.	**10**
IV.	Solution of Berger's equation for Inviscid and Viscous flow using implicit and explicit methods. Solution of Wave equation – Euler explicit method – Lax method – Upwind method – MacCormack method – Leap Frog method etc.	**10**
Total		**40**

Text Books:

1. Johan D Anderson, JR., "Computational Fluid Dynamics" McGraw-Hill Education Private Ltd, New Delhi.

Reference Books:

1. Johan D Anderson, JR., "Computational Mechanics and Heat Transfer" Taylor & Francis.
2. T. J. Chung, "Computational Fluid Dynamics" Cambridge University Press.
3. Verlag., "Computational techniques for Fluid Dynamics" Fletcher and Springer.
4. Charlse and Hirch., "Numerical Computation of Internal and External flows" John-Wiley
5. John C. Tannehill, Dale A. Anderson and Richard H. Pletcher, "Computational Fluid Mechanics and Heat Transfer" Taylor &Francis.

Course: B.Tech. (M.E)	SYLLABUS	Semester: VIII
Paper II / Core Elective V		
Subject Name: Fluid Power Control		Subject Code: MEE022D8022
L-T-P-C – 3-0-0-3	Credit Units: 03	Scheme of Evaluation: T

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • The course is designed to give the fundamentals of fluid power transmission and drive technology. • It familiarizes with the main components, their design as well as static and dynamic characteristics. • It enables the students to design complex fluid power systems by use of simulation	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Students understand the functioning of the main hydraulic and pneumatic components • Read circuit diagrams and to understand the principles of circuit operation, in relation to the performance of the individual components themselves. • Design and predict the behavior of practical hydraulic controlled systems.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	What is fluid power; Applications and advantages; Components of a hydraulic and pneumatic system. Desired properties of a hydraulic fluid; advantage of mineral oil over water; definition of terms like pressure, head, force, density, specific gravity, kinematic and absolute viscosity, compressibility and incompressibility. Pascal's law; analysis of simple hydraulic jack, Mechanical advantage; continuity equation; hydraulic power of a cylinder Hydraulic Pumps: positive displacement pumps; constructional features, working principle and volumetric capacity of external gear pump, vane pump, axial piston pump and radial piston pump.	**10**

II.	Hydraulic Actuators: Constructional features of single acting and double acting hydraulic cylinders; mounting of cylinders, cushioning of cylinder; different application of cylinder through mechanical linkages; force, velocity and power from a cylinder. Hydraulic motors; torque, power and flow rate in a hydraulic motor. Hydraulic Valves: Direction control valves –operation and graphical symbol of 3 way and 4-way valves; different modes of activation of valves; Operation and graphical symbols of check valves, pressure relief valve pressure reducing valve, unloading valve and flow control valve.	**10**
III.	Pneumatics: Advantages & disadvantages of pneumatic system compared to hydraulic system; constructional details and operation of a reciprocating compressor; working principle and use of filter, pressure regulator, lubricator and silencer; symbols of different pneumatic components; compressed air distribution system in a plant; drawing pneumatic circuits for different operations.	**10**
IV.	Use of electrical devices for controlling fluid circuits; function of electrical devices like pushbutton switches, limit switches, pressure switches, solenoids, relays and timers and their symbols; concept of ladder diagram; study of following circuits using electrical control devices: i) control of a solenoid actuated cylinder using one limit switch; ii) reciprocation of a cylinder using pressure or limit switches, iii) two-cylinder sequencing circuit using two limit switches.	**10**
Total		**40**

Text Books:

1. John Watton: Fundamentals of Fluid Power Control. 1 st Ed. Cambridge University Press, 2009

Reference Books:

1. Manring, Noah D.: Hydraulic control systems. 1st Ed. John Wiley & Sons, 2005
2. Beater, Peter: Pneumatic drives. Springer, 2007
3. Merrit, Herbert E.: Hydraulic control systems. John Wiley & Sons, 1967
4. Esposito, Anthony.: Fluid power with applications, 7th Ed. Prentice Hall, 2009.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VIII**
Paper III / Core Elective VI		
Subject Name: Energy Conservation and Management		**Subject Code: MEE022D8031**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	*Teaching Learning Process*	*Learning Outcomes*	*Course Evaluation*
The objectives of the course are:- • To provide understanding in the energy data from industries and to carry out energy audit for energy savings.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • To perform of energy auditing for the energy consumption of industries.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Introduction to energy & power scenario of world, National Energy consumption data, environmental aspects associated with energy utilization; Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing..	**10**
II.	Components of EB billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics; Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting.	**10**
III.	Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation and energy conservation measures; Steam distribution and usage, steam traps, condensate recovery, flash steam utilization; Insulation & Refractories.	**10**
IV.	Energy conservation in major utilities; pumps, fans, blowers, compressed air systems, Refrigeration& Air Conditioning systems, Cooling Towers, DG sets. Energy Economics- discount period, payback period, internal rate of return, net present value; Life Cycle costing- ESCO concept.	**10**
Total		**40**

Text Books:

1. Murphy W.R. and McKay G., Energy Management, Butterworths, London, 1987.

Reference Books:

1. Witte L.C., Schmidt P.S. and Brown D.R., Industrial Energy Management and Utilization, Hemisphere Publ., Washington, 1988..
2. Callaghn P.W., Design and Management for Energy Conservation, Pergamon Press, Oxford, 1981.
3. Energy Manager Training Manual, Bureau of Energy Efficiency (BEE) under Ministry of Power, GOI, 2004 (available at www.energymanager training.com).

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VIII**
Paper III / Core Elective VI		
Subject Name: Metrology & Instrumentation		**Subject Code: MEE022C8032**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	*Teaching Learning Process*	*Learning Outcomes*	*Course Evaluation*
The objectives of the course are: - • To Understand the working of linear and angular measuring instruments. • To familiarize with the working of optical measuring instruments and fundamentals of limits and limit gauges • To Understand the working principle of different types of comparators. • To give basic idea about various methods for measurement of screw thread and surface finish parameters. • To provide basic idea about working principle and applications of devices for measurement of force and torque, strain and stress and temperature.	1. Lecture 2. Assignment 3. Individual andGroup Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • Will be able Understand the principle of linear and angular measuring instruments and will apply the acquired knowledgefor the accurate and precise measurement of a given quantity. • Will demonstrate the ability to apply the principle of limits, fits and tolerance while designing and manufacturing the components of their requirement • Will understand the fundamentals of various methods for the measurements of screw threads, surface roughness parameters and the working of optical measuring instruments. • Will become familiarized with various advanced measuring devices and machine tool metrology. • Will be able to use various devices for measuring torque, force, strain, stress and temperature. • Demonstrate the ability to analyze the results of various measuring systems and instruments for motion and dimensional measurements and can infer the results to give better conclusions.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar,Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	**Introduction To Measurements – Linear, Angular:** Introduction to Metrology: Need for high precision measurements; Terminologies in Measurement-Precision, accuracy, sensitivity, calibration. Errors in Measurement, types of errors. Basic standards of length- Line standard, End standards, Wavelength standard; Various Shop floor standards. **Linear Measurement** – Slip gauges, wringing, grades; Surface plate; Dial indicators; Height gauges and Vernier calipers. Comparators- mechanical, electrical, optical and pneumatic. **Angular Measurement** – Bevel protractor; Sine Bar, Principle and use of sine bar; Angle gauges. Sprit level; Angle Dekkor.	**10**
II.	**System of Limits, Fits, Tolerance and Gauging:** Definitions, Tolerance, Tolerance analysis (addition & subtraction of tolerances) Interchangeability & Selective assembly. Class & grade of tolerance, Fits, Types of fits, Numerical on limits, fit and tolerance. Hole base system & shaft base system. Taylor's principle, Types of limit gauges, Numerical on limit gauge design.	**10**
III.	**Measurement of Screw Thread and Surface Texture:** **Screw thread measurement** – Screw thread terminology; Measurement of major diameter; Measurement of minor or root diameter. Measurement of pitch; Measurement of effective diameter with two wire method and three wire method. Measurement of flank angle and form by profile projector and microscope. **Measurement of surface texture** – Meaning of surface texture, roughness and waviness; Analysis of surface traces, peak to valley height, R.M.S. value, Centre Line Average and R value, Rt, Rz etc. Methods of measuring surface roughness – Stylus probe, Tomlinson surface meter, Talysurf;Terms used in surface roughness measurement – assessment length, roughness width cutoff, sampling length and evaluation length. Interferencemethod for measuring surface roughness – using optical flat and interferometers. Autocollimator, principle and use of autocollimator.	**10**
IV.	**Instrumentation**: **Transducers:** Transfer efficiency, Primary and Secondary transducers, Electrical transducers, Mechanical, Electronic transducers, Relative comparison of each type of transducers. **Applied mechanical measurement:** Measurement of force, Torque, Pressure, Types of Dynamometers, Absorption dynamometer, Prony brake and Rope brake dynamometer, and Power Measuring Instruments. Use of elastic members, Bridgeman gauge, McLeod gauge, Pirani gauge. **Measurement of strain and temperature:** Theory of strain gauges, Types, Electrical resistance strain gauge, Preparation and mounting of Strain gauges, Gauge factor, Methods of strain measurement, temperature compensation, Resistance thermometers, Thermocouple, Law of thermocouple, Pyrometer, Optical pyrometer.	**10**
Total		**40**

Text Books:

1. Gaylor, Shotbolt and Sharp, "Metrology for Engineers", 5th Edition, O.R. Cassel, London, 1993.
2. Mahajan.M., "A text-Book of Metrology", Dhanpat Rai & Co. (P) Ltd., 2006
3. R.K.Jain Engineering Metrology , Khanna Publishers, 2005

Reference Books:

1. Kumar D.S Mechanical Measurement and Control – Metropolitan Book company Pvt. Ltd. – 1989
2. T.G.Beckwith and N.Lewis Buck, Mechanical Measurements, Addison Wesley, 2001
3. Sirohi, R.S. and Radhakrishnan, H.C.Mechanical Measurements, New Age, 1994.
4. Hume K. J., Engineering Metrology, Macdonald &Co. Ltd.,1990
5. Anand K Bewoor, Vinay A Kulkarni, Metrology & Measurement, McGraw-Hill, 2009

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VIII**
Paper III / Core Elective VI		
Subject Name: Product Design Methodologies and Inventive Problem Solving		
		Subject Code: MEE022D8032
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	*Teaching Learning Process*	*Learning Outcomes*	*Course Evaluation*
The objectives of the course are:- • Development of design management and creative skills with a perspective to produce successful engineering design. • Project management skills • Inventive problem-solving skills for the development of novel solution to engineering problems.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • The students shall be able to demonstrate the ability to approach the design problem in a systematic way to develop feasible design solution. • The students shall be able to select and apply the problem-solving tools to develop novel solution which is cost effective in minimum feasible time. • The course will go a long way to promote inventive and design thinking amongst the budding engineers.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Product development process tools, scoping product developments: Technical and business concerns; Understanding customer needs, -business case analysis, design drivers, Understanding customer needs- Voice of customer, Customer population, types of customer needs, Organising and prioritizing customer needs, affinity diagram; Establishing product functions FAST method, QFD, Product teardown and experimentation- SOP method, Benchmarking and establishing specifications, product portfolios and portfolio architecture.	**10**

II.	Embodiment engineering - Product architecture, Generation of concept-Traditional Brain storming, 6-3-5 method/C sketch, concept Morphological analysis; Concept selection-Pugh charts, Product testing experimentation-design of experiments, Physical model and experimentation, regression and response surface optimisation, Taguchi method as a special case of response surface optimisation, Process control charts	**10**
III.	Stage Gate model, water fall model and spiral model for project management-engineering products and software development, PERT CPM, Six Sigma process DMAIC/DMADV models, basics of AGILE methodology, Variation risk management, Dimensioning and tolerancing of components and assemblies.	**10**
IV.	TRIZ-Introduction to the suite of TRIZ tools and ARIZ, Trends of ideality and S curves, 9 windows tool, Dimension Time and cost operator, Function modelling, 40 inventive principles, TRIZ contradiction matrix,76 standard solutions and Su field analysis.	**10**
Total		**40**

Text Books:

(1) Kevin Otto, Kirsten Wood, (2018) Product design- Techniques in reverse engineering and new product development, Pearson publications, 7/e,
(2) Paul J Drake, Jr, (1999), Dimensioning and tolerancing handbook, McGraw-Hill Book Company.
(3) David G Cameron, 2017, TRIZICS, Amazon publication.

Reference Books:

(1) David G Ulman, (2018), Mechanical design process, McGraw-Hill Book Company, 6/e.
(2) K Ulrich and S Eppinger, (2011), Product Design and Development, McGraw-Hill Book Company, 6/e.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VIII**
Paper IV / Open Elective IV		
Subject Name: Process Planning and Cost Estimation		**Subject Code: MEE022G8041**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	*Teaching Learning Process*	*Learning Outcomes*	*Course Evaluation*
The objectives of the course are:- • To introduce process planning concepts to make cost estimation for various products	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • To use the concepts of process planning and cost estimation for various products	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	Introduction of Process Planning- methods of process planning, drawing interpretation, material evaluation, steps in process selection, production equipment and tooling selection	**10**
II.	Process planning activities- process parameter calculation for various production processes, selection of jigs and fixtures, selection of quality assurance methods, documents for process planning, economics of process planning, case studies	**10**
III.	Introduction to cost estimation- importance of costing and estimation, methods of costing, elements of cost estimation, types of estimates, estimating procedure, estimation of labor cost, material cost, allocation of overhead charges, calculation of depreciation cost	**10**
IV.	Machining time estimation- importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations, Machining time calculation for Milling, Shaping, Planing and Grinding Production costs- different production processes for different jobs, estimation of forging cost, estimation of welding cost, estimation of foundry cost, estimation of machining cost	**10**
Total		**40**

Text Books:

1. Peter Scalon, Process Planning, Design/ Manufacture Interface, Elsevier Sci.&Tech. 2002.
2. Ostwaal P.F. and Munez J., Manufacturing Processes and Systems, 9th ed., John Wiley 1998.

Reference Books:

1. Chitale A.V. and Gupta R.C., Product Design and Manufacturing, 2nd ed., Prentice Hall, 2002

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VIII**
Paper IV / Open Elective IV		
Subject Name: Problem solving using MATLAB & Simulink		**Subject Code: MEE022G8042**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Course Objective	Teaching Learning Process	Learning Outcomes	Course Evaluation
The objectives of the course are:- • To provide understanding of the Matlab Desktop, Command window and the Graph Window and learn to do simple and complex calculation using Matlab. • To show how to carry out numerical computations and analyses. • To emphasize the mathematical concepts upon which numerical methods rely. • To provide knowledge of the Simulink environment and to model engineering problems in Simulink.	1. Lecture 2. Assignment 3. Individual and Group Presentation 4. Quiz 5. Class test 6. Viva-Voce	On successful completion the student will be able to: • To use MATLAB & Simulink for scientific computations including physical system of controller design & different optimization techniques.	• Continuous Evaluation: 15% (Assignment, Class Test, Viva, Seminar, Quiz : Any Three) • Mid-term examination: 10% • Attendance: 5% • End Term Examination: 70%

Detailed Syllabus:

Modules	Topics / Course content	Hours
I.	**INTRODUCTION TO MATLAB PROGRAMMING & SIMULINK** Basics - variables, arrays, matrices, plotting. Basics - operators, functions, strings, cells, Matrices, Plotting, User-defined functions, Input-output formatting, Relational & logical operations, Loops, Solving Differential equations by ODE45. Simulink Basics – Working with blocks, Block settings, model annotation, sources and sinks library, User defines functions, Signal routing and logicals, integration and differentiation, Matlab and Simulink working together.	**10**

II.	Free Body Diagram, Equilibrium equations, D'Alembert's Law for deriving the equations of motion; Difference between Linear & Non-Linear Systems; Spring-Mass Damper system; Modelling of a System for Controller Design	**10**
III.	Frequency Domain Techniques – Bode Plot, Nyquist & Inverse Nyquist Diagram; Routh Hurwitz criterion for stability of a control system; PID controller; Ziegler Nichols Plot for Tuning PID controller; Root Locus Method for controller design; Linear Time Invariant System; Ackerman Principle; Observer Design	**10**
IV.	Single variate problems – Bracketing Methods, Region Elimination Methods, Gradient – based Methods Multi variate problems – Direct Search Methods, Gradient Based Methods	**10**
Total		**40**

Text Books:

1. Amos Gilat, *MATLAB: An Introduction with Applications*, 4th edition (or later), WILEY STUDENT EDITION
2. Robert H. Canon Jr., *Dynamics of Physical Systems*, Courier Corporation
3. Kalyanmoy Deb, *Optimization for Engineering Design: Algorithms and Examples*, 2nd edition, PHI publication.
4. Ogata K, *Modern Control Engineering*, 4th edition, PHI publication

Reference Books:

1. Benjamin C. Kuo, Farid Golnaraghi, *Automatic Control Systems*, 9th edition, WILEY STUDENT EDITION
2. Brian R. Hunt, Jonathan Rosenberg, and Ronald L Lipsman , "A Guide to MATLAB: For Beginners and Experienced Users", Cambridge Publication.
3. Steven T. Karris , "Introduction to Simulink with Engineering Applications", Orchard Publications.

Course: B.Tech. (M.E)	**SYLLABUS**	**Semester: VIII**
Paper V / Subject Name: Project II		**Subject Code: MEE022C825**
L-T-P-C – 0-0-10-5	**Credit Units: 05**	**Scheme of Evaluation: T**

Course Objective	*Teaching Learning Process*	*Learning Outcomes*	*Course Evaluation*
The objectives of the course are:- • To practice the steps involved for the selection, execution, and reporting of the project.	1. Individual and Group Presentation 2. Viva-Voce	On successful completion the student will be able to: • Identify real world problems of mechanical engineering and related systems. • Interpret the working of mechanical engineering systems. • Apply the principles of mechanical engineering in real world systems. • Criticize and experiment to arrive at solutions for real world mechanical engineering problems.	• End Term Examination: 100%

During VIIIth semester, each student is required to complete the project as per the plan made in the preliminary report submitted during the VIIth semester. At the middle of the VIIIth semester an Interim Evaluation will be carried out by the evaluation committee constituted in the previous semester. At the end of the semester, each student should also appear for Final Evaluation.

Interim Evaluation of the project should be done at the middle of the eighth semester by the committee. Each student should submit a copy of the Interim Report of the Project before the committee. Also, copies of the Approval of Project and Preliminary Report shall be submitted to the evaluation committee. The committee will award marks based on the student-wise performance. The respective guide will award the individual internal marks