

**Course Structure of B.Tech. – Mechanical Engineering
Specialization in Automobile Engineering
Applicable for 2017-2021**

**DIT UNIVERSITY
Dehradun**



**Detailed Course Structure
Of**

**B.Tech. – Mechanical Engineering Specialization in
Automobile Engineering**

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

Course Structure

Year: 1st

Semester: I

Course Category	Course Code	Course Title	L	T	P	Credit
UC	MA101	Engineering Mathematics-I	3	1	0	3.5
UC	PY101	Engineering Physics	3	1	2	4.5
UC	HS101	Professional Communication	2	1	1	3
UC	CS101	Computer Fundamental & C Programming	3	0	2	4
UC	ME104	Workshop Practice	0	0	2	1
UC	EE101	Introduction to Electrical and Electronics Engineering	3	1	2	4.5
UC	EE102	Electrical & Electronics Measurements	1	0	2	2
		Total				22.5

Year: 1st

Semester: II

Course Category	Course Code	Course Title	L	T	P	Credit
UC	MA102	Engineering Mathematics-II	3	1	0	3.5
UC	HS102	Corporate Communication and Soft Skills	2	1	1	3
UC	CS102	Computer Programming in C++	3	0	2	4
UC	ME101	Engineering Mechanics	3	1	0	3.5
UC	ME102	Mechanical Measurements	1	0	2	2
UC	ME103	Engineering Graphics	0	0	3	1.5
UC	CH101	Engineering Chemistry	3	1	2	4.5
		Total				22

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Year: 2nd

Semester: III

Course Category	Course Category	Course Code	L	T	P	Credit
AC	CH201/HS244	Environmental Science / Indian Constitution	2	0	0	0
SC	MA201	Engineering Mathematics – III	3	1	0	4
DC	ME205	Thermodynamics and Heat Engines	3	1	0	4
DC	ME202	Strength of Materials	3	1	0	4
DC	ME203	Materials Engineering	3	0	2	4
DC	ME204	Manufacturing Processes	3	0	2	4
EC	EC210	Introduction to Electronics & Communication	3	0	2	4
		Total	20	3	6	24

Year: 2nd

Semester: IV

Course Category	Course Code	Course Title	L	T	P	Credit
AC	CH201/HS244	Environmental Science / Indian Constitution	2	0	0	0
DC	ME206	Theory of Machines	3	1	2	5
DC	ME207	Fluid Mechanics & Fluid Machines	3	1	2	5
DC	ME211	Basic Automobile Engineering	3	0	2	4
DC	ME209	Design of Machine Elements	3	1	2	5
DC	ME210	M/c Drawing & Solid Modelling	0	0	4	2
HE		Humanities Elective-I	2	0	0	2
		Total	16	4	10	23

Humanities Elective 1

Course Code	Course Title
HS241	Education and Social Change
HS242	Introduction to Psychology
HS243	Science, Technology and Society
HS245	Ethics and Self-Awareness

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Year: 3rd

Semester: V

Course Category	Course Code	Course Title	L	T	P	Credit
DC	ME301	Heat Transfer	3	1	2	5
	ME302	Manufacturing Technology	3	0	2	4
	ME303	Fluid Machinery- Lab Course	0	0	2	1
DE		Department Elective 1				4
		Department Elective 2				4
		Department Elective 3				3
HE		Humanities Elective-2	2	0	0	2
PRJT	ME311	Study Project	0	0	4	2
ST	ME312	Summer Training Evaluation				0
AC	HS301	Aptitude & Soft Skills- 3	3	0	0	0
AC		Value Added Training	0	0	2	0
		Total	17	2	12	25

Department Elective 1

Course Code	Course Title	L-T-P	Credits	Pre-requisite
ME368	Automotive Transmission Systems	3-1-0	4	ME206, ME209
ME369	Vehicle Design Data & Characteristics	3-1-0	4	ME211
ME347	Advanced Theory of Machine	3-1-0	4	ME206, ME209

Department Elective 2

Course Code	Course Title	L-T-P	Credits	Pre-requisite
ME346	Turbomachines	3-1-0	4	ME207
ME348	Advanced Design of Machine Elements	3-1-0	4	ME209
ME350	Operations Research	3-1-0	4	
ME349	Automotive Electrical and Electronics	3-0-2	4	EC210

Department Elective 3

Course Code	Course Title	L-T-P	Credits	Pre-requisite
ME341	Energy Conservation & Management	3-0-0	3	ME205, ME208
ME342	Composite Materials	2-1-0	3	ME202, ME203
ME345	Industrial Engineering & Management	3-0-0	3	

Humanities Elective 2

Course Code	Course Title
HS384	Principles of Management
HS385	Engineering Economics
HS391	Positive Psychology & Living
HS382	Literature, Language and Society

Value Added Training

Course Code	Course Title
ME331	Flexible Manufacturing System
ME332	Electro Discharge Machining
ME333	CREO Design Software
ME334	Advanced Welding
ME335	MATLAB
ME336	ANSYS

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Semester: VI

Course Category	Course Code	Course Title	L	T	P	Credit
DC	ME304	Advance Automobile Engineering	3	0	2	4
DE		Department Elective-4				4
		Department Elective-5				4
		Department Elective-6				4
		Department Elective-7				3
PRJT	ME313	Design/LAB Project – I	0	0	10	5
AC	ME314	Industrial Tour				0
AC	HS304	Aptitude & Soft Skills- 4	3	0	0	0
		Total	18	1	16	24

Department Elective 4

Course Code	Course Title	L-T-P	Credits	Pre-requisite
ME351	Design of Heat exchangers	3-1-0	4	ME301
ME352	Tribology	3-0-2	4	ME207
ME353	Vehicle Maintenance	3-0-2	4	ME211
ME354	Computer Aided Design	3-0-2	4	ME210

Department Elective 5

Course Code	Course Title	L-T-P	Credits	Pre-requisite
ME355	Design for Manufacturing	3-0-2	4	ME204
ME356	Automotive Fuel And Lubricants	3-0-2	4	ME201,ME207
ME358	IC Engines	3-0-2	4	ME205
ME371	Automobile System Design	3-1-0	4	ME211, ME206, ME209

Department Elective 6

Course Code	Course Title	L-T-P	Credits	Pre-requisite
ME357	Computational Fluid Dynamics	3-0-2	4	ME201, ME207, ME301
ME359	Computer Integrated Manufacturing	3-0-2	4	ME204
ME370	Automobile Component Design	3-1-0	4	ME211, ME206, ME209
ME372	Vehicle Dynamics	3-1-0	4	ME211, ME209

Department Elective 7

Course Code	Course Title	L-T-P	Credits	Pre-requisite
ME363	Industrial Ergonomics	3-0-0	3	ME345
ME373	Auto Pollution & Control	3-0-0	3	
ME364	Renewable Energy Systems	3-0-0	3	ME205, ME301
ME365	Nuclear Power Engineering	3-0-0	3	ME205, ME301
ME366	Product Design Development	3-0-0	3	ME209
ME361	Industrial Robotics	2-0-2	3	EC210
ME367	Plant Layout & Material Handling	3-0-0	3	ME349

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Year: 4th

Semester: VII

Course Category	Course Code	Course Title	L	T	P	Credit
DE		Department Elective-8				3
		Department Elective-9				3
		Department Elective-10				3
OE		Open Elective-1	3	0	0	3
PRJT	ME401	Design/LAB Project – II	0	0	16	8
AC	HS311	Employment Enhancement Program	2	0	0	0
UC	ME381	Entrepreneurship & Start Up	2	0	2	3
		Total	13	1	20	23

Open Elective- 1

Course code	Course Title	L	T	P
CS481	Software Quality Engineering	3	0	0
IT353	Basics of Data Science	3	0	0
IT356	Multimedia	3	0	0
EC383	Consumer Electronics	3	0	0
EC385	Analog Electronics	3	0	0
EE481	New and Renewable Energy Sources	3	0	0
PE481	Fuel Technology	3	0	0
PE482	Health Safety and Environment in Industry	3	0	0
MA451	Statistical Techniques & their application	3	0	0
AR481	Graphics & Product Design	3	0	0
CS481	Software Quality Engineering	3	0	0

Year: 4th

Semester: VIII

Course Category	Course Code	Course Title	L	T	P	Credit
IND	ME403	Industrial Project/ Internship				16
Or						
OE		Open Elective-2	3	0	0	3
		Open Elective-3	3	0	0	3
		Open Elective-4	3	0	0	3
DE		Department Elective-11				3
HE		Humanities Elective-3	2	0	0	2
		Total	13	0	2	14

Humanities Elective 3

Course Code	Course Title
HS493	Indian Culture & Tradition
HS483	Indian Philosophy
HS491	Industrial Sociology
HS485	Sustainable Development

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Department Elective 8 to 11

Course Code	Course Title	L-T-P	Credits	Pre-requisite
ME458	Automotive Refrigeration and Air Conditioning	2-1-0	3	ME205, ME301
ME442	Gas Turbines & Jet Propulsion	2-1-0	3	ME205, ME301
ME443	Design of Transmission System	2-1-0	3	ME206, ME209
ME444	Avionics	3-0-0	3	ME205, ME207
ME445	Total Quality Management	3-0-0	3	ME345
ME446	Design of Hydraulics & Pneumatics System	2-0-2	3	ME207
ME459	Special Vehicles & Equipment	3-0-0	3	ME304
ME449	Micro & Nano Machining	2-0-2	3	ME204
ME451	Finite Element Analysis	2-0-2	3	ME202, ME203
ME460	Vehicle Body Engineering	3-0-0	3	ME304
ME447	Mechanical Vibration	2-1-0	3	ME209
ME450	Automatic Control	2-1-0	3	MA201
ME461	Alternate Fuel & Energy	3-0-0	3	ME205, ME358
ME462	Emerging Automotive Technologies	3-0-0	3	ME304
ME452	Solar Energy Systems	2-1-0	3	ME205, ME301
ME453	Machine Tool Design	2-1-0	3	ME204, ME209
ME454	Principle of Management	3-0-0	3	
ME455	Advanced Engineering Materials	2-1-0	3	ME202, ME203
ME456	Non-Destructive Testing	2-0-2	3	ME202, ME203
ME457	Welding Technology	2-0-2	3	ME202, ME203

Open Elective- 2, 3 and 4

Course code	Course Title	L	T	P
CS482	Human Computer Interaction	3	0	0
IT357	Internet of Things	3	0	0
IT359	Mobile Computing and Services	3	0	0
EC386	Fundamental of communication & Networks	3	0	0
EC382	Biomedical Instrumentation	3	0	0
EE485	Basic Instrumentation & Process Control	3	0	0
CE483	GIS	3	0	0
PE491	Carbon Capture and Sequestration Technology	3	0	0
MA452	Optimization Techniques	3	0	0
AR485	Art Appreciation	3	0	0
PY481	Nano scale science and technology	3	0	0

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Summary of the Credit

Year	Semester	Credit
1	1	22
	2	22.5
2	3	24
	4	23
3	5	25
	6	24
4	7	23
	8	16 / 14
Total		179.5 / 177.5

Category wise classification of the Credit

Category	Credits	No. of Subjects
AC	0	7
DC	51	13
DE	38	11
EC	4	1
HE	6	3
IP/THESIS	16	1
OE	12	4
PRJT	15	3
SC	4	1
ST	0	1
UC	47.5	15
Grand Total	179.5 / 177.5	60

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Subject Code	MA101	Subject Title	Engineering Mathematics-I						
LTP	3-1-0	Credit	3.5	Subject Category	UC	Year	1 st	Semester	I/II

OBJECTIVE: To introduce the fundamentals in Differential, Integral and Vector Calculus relevant to engineering applications.

Unit I : Differential Calculus I

Functions of one variable, Definitions of Limit, Continuity and Differentiation. Basic Theorems for each of these concepts, Successive Differentiation, Leibnitz Theorem, Taylor's Theorem with remainder, Rolle's Theorem, Mean Value Theorem and their applications. Critical points, Local Maxima & Minima, Increasing & Decreasing, Concavity, Points of inflection, Asymptotes of functions and their use in drawing neat sketch of its graph.

Unit II: Differential Calculus II

Functions of two or more variables, concept of Limit and Continuity, Partial Differentiation, Euler's theorem for Homogeneous functions, Chain rule, Total differential, Local Maxima, minima, Lagrange's Multiplier method, Taylor Series.

Unit III: Integral Calculus

Indefinite integrals, Fundamental theorem of Integral Calculus. Definite integral and its applications. Improper Integrals, Gamma and Beta functions, Double & Triple integration, Change of order of integration, Change of Variables. Dirichlet's Integral. Applications of multiple integrals.

Unit IV Vector Calculus

Scalar & Vector functions, Scalar & Vector fields, Gradient of a scalar function and its applications, Directional derivative. Divergence & Curl of a Vector function and their applications. Line integral, Surface integral. Statements of Green's Theorem, Stokes Theorem and Divergence Theorem and their applications

LEARNING OUTCOME: Familiarity with fundamental tools of Differential, Integral and Vector Calculus relevant to engineering applications

Text Books:

1. G. B. Thomas Jr. & R. L. Finney, Calculus and Analytic Geometry, 9th Edition, Pearson Education

Reference Books:

1. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, U.K., 2006.
2. R. K. Jain and S.R.K. Iyenger, Advanced Engineering Mathematics, 2nd edition, Narosa Publishing House, New Delhi, India, 2006

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Subject Code	PY101	Subject Title	Engineering Physics						
LTP	3-1-2	Credit	4.5	Subject Category	UC	Year	1 st	Semester	I/II

OBJECTIVES

- The student will acquire a strong background in Applied Physics that will serve as a basis for engineering problem solving.
- The student will learn the basic concepts found in Oscillations and Waves, Optics, Quantum Mechanics, Nanotechnology and Lasers.
- The students will acquire problem-solving and analytical skills that will help in preparation for areas of engineering chosen.
- The students will learn how to demonstrate the application of the scientific methods through laboratory experiments thereby verifying the concepts related to theory content knowledge.
- The students will learn to demonstrate the ability to communicate scientific information effectively in written and oral formats.

UNIT I:

Oscillations and Waves: Oscillations, Simple Harmonic Motion: Equation of Simple Harmonic Motion, Characteristics of SHM, Energy, Free Oscillations, Damped Oscillations, Forced Oscillations, Resonance, Coupled Oscillations, Waves: Travelling waves, wave equation, types of waves, Reflections and Transmission of Waves at a boundary. (6) L

UNIT II:

Interference: Fringes with white light, Interference in plane parallel thin film (reflected and transmitted case), Wedge shape film (reflected case), Newton's Rings and its application to determine wavelength of monochromatic light and refractive index of a liquid. **Diffraction:** Difference between Interference and Diffraction, Fraunhofer diffraction due to a single slit: resultant intensity, conditions of maxima and minima, angular and linear width of central maximum, N slit diffraction: resultant intensity, conditions of maxima and minima, missing orders, angular width of principal maxima. (10) L

UNIT III:

Polarization: Polarized and unpolarized light and its pictorial representation, plane of polarization and plane of vibration, Phenomenon of Double Refraction, positive and negative double refracting crystals, properties of ordinary and extra-ordinary rays, Nicol Prism and its applications as a polarizer and analyzer, Mathematical analysis of superposition of two linearly polarized light vectors, retardation plates-half and quarter wave plates, Production and detection of Plane, Circularly and Elliptically Polarized light. (8) L

UNIT IV:

Quantum Mechanics: Concept of wave packet, group and phase velocity, Heisenberg Uncertainty Principle and its applications viz. non-existence of electron in nucleus, radius and energy of Bohr's first orbit, Schrödinger time independent and time dependent wave equation, Physical interpretation of wave function, normalization condition of the wave function, Application of Schrodinger wave equation: Particle in a one dimensional box (eigen function and eigen values) and rectangular potential barrier. (8) L

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UNIT V:

Nanotechnology: Introduction to Nanomaterial, Classification of nanomaterials, application of nanotechnology. **Lasers:** Spontaneous and Stimulated emission, Stimulated Absorption, Einstein's A & B Coefficient, metastable states, population inversion, basic principle of laser (three level and four level), optical cavity and resonator, He-Ne laser. (8) L

List of Experiments

1. To determine the wavelength of monochromatic light by Newton's Ring.
2. To determine the specific rotation of cane sugar solution using bi-quartz polarimeter.
3. To determine the wavelength of spectral lines using plane transmission grating.
4. To study the variation of magnetic field along the axis of a current carrying coil and then to estimate the radius of coil.
5. To Study the nature of polarization of Laser light and verify Malus Law
6. To Measure the acceleration due to gravity 'Value of g' using bar pendulum
7. To measure the frequency of ac mains using sonometer.
8. To measure the numerical aperture (NA) of an optical fibre.
9. Measurement of thickness of wire using LASER beam.
10. To study the characteristics of a Photovoltaic cell.

LEARNING OUTCOMES:

- Demonstrate a detailed knowledge of Oscillations, Optics, Quantum Mechanics, Lasers and Nanotechnology.
- Discuss how laws of Physics can be applied in the understanding and development of engineering systems.
- An ability to communicate scientific information effectively in written and oral formats.
- Skills to perform experiments in the physics laboratory with ability to work independently and an ability to analyze and interpret data in the physics laboratory.

Text Books:

- Ajoy Ghatak; Optics; Tata Mc-Graw Hill Education, 2009.
- Arthur Beiser; Concepts of Modern Physics; Tata Mc-Graw Hill Education, 2003

Reference Books:

- Jenkins and White; Fundamentals of Optics; Fourth; McGraw-Hill, 2000
- Young and Freedman; Sears and Zemansky's University Physics, Tenth; Addison-Wesley, 2000.

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Subject Code	HS101	Subject Title	Professional Communication						
LTP	2-1-1	Credit	3.0	Subject Category	UC	Year	1 st	Semester	I/II

OBJECTIVES

- To promote efficiency in English Language with the development of the four skills of communication i.e., LSRW (Listening, Speaking, Reading & Writing).
- To help students perform better in all academic subjects through greater command over the English language.
- To develop technical writing skills with a focus on critical thinking, rhetorical analysis, effective writing & effective document design.

Unit-I

Communication 6 hrs

Communication: Meaning, Types of Communication: General & Technical Communication
Barriers to Communication, Overcoming strategies.

Unit II

Non Verbal Communication 3 hrs

Knowledge and adoption of Non Verbal cues of communication: Kinesics, Proxemics, Chronemics, Oculesics, Haptics, Paralinguistics

Unit III

Listening & Speaking Skills 6 hrs

Listening Comprehension: identifying General & Specific information, Note taking and drawing inferences

Introduction to Phonetics : Articulation of consonants and vowel sounds.

Public Speaking

Discussion Techniques

Unit IV

Reading Skills 4 hrs

Reading Strategies and Vocabulary Building

Reading Comprehension

Unit V

Technical Writing Skills 7 hrs

Paragraph development

Technical Articles, Research Articles, Plagiarism

Intra office Correspondence: Notice, Agenda, Minutes and Memorandum,

Technical Proposal & Report

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LEARNING OUTCOMES

- Build confidence of the students through practice of the basic skills of the basic skills of communication.
- The students will be equipped to comprehend a variety of content & develop deeper insight.
- Enable the students to effectively create standard formats used to construct meaningful documents.

TEXT BOOKS

1. Rizvi, Ashraf. Effective Technical Communication, McGraw Hill, New Delhi. 2005.
2. Lata, Pushp and Sanjay Kumar, Communication Skills, Oxford University Press, New Delhi. 2011.

REFERENCE BOOKS

1. Aslam, Mohammad. Introduction to English Phonetics and Phonology Cambridge.2003.
2. Ford A, Ruther. Basic Communication Skills; Pearson Education, New Delhi.2013.
3. Gupta, Ruby. Basic Technical Communication, Cambridge University Press, New Delhi.2012.
4. Kameswari, Y. Successful Career Soft Skills and Business English, BS Publications, Hyderabad.2010.
5. Tyagi, Kavita & Padma Misra. Basic Technical Communication, PHI, New Delhi. 2011.

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Subject Code	CS101	Subject Title	Computer Fundamental & C Programming						
LTP	3-0-2	Credit	4.0	Subject Category	UC	Year	1 st	Semester	I/II

OBJECTIVES

The objective of the course is to make the students to understand the key hardware components in a modern computer system and as to how the software is mapped to the hardware. The student shall also be able to learn make the computer programs using C language by exploring the various features of C.

Unit-1

8L

Basics of Computer: Introduction to digital computer, basic operations of computer, functional components of computer, Classification of computers.

Introduction to operating system: [DOS, Windows, Linux and Android] purpose, function, services & types.

Number System: Binary, octal and hexadecimal number systems, their mutual conversions, **Binary arithmetic.**

Basics of programming: Approaches to Problem Solving, Concept of algorithm and flow charts, **Types of computer languages:- Machine Language, Assembly Language and High Level Language,** Concept of Assembler, Compiler, Loader and Linker.

Unit-2

8L

Standard I/O in C, Fundamental data types- Character type, integer, short, long, unsigned, single and double floating point, Storage classes- automatic, register, static and external, Operators and expression using numeric and relational operators, mixed operands, type conversion, logical operators, bit operations, assignment operator, operator precedence and associativity.

Fundamentals of C programming: Structure of C program, writing and executing the first C program, components of C language. Standard I/O

Unit-3

8L

Conditional program execution: Applying if and switch statements, nesting if and else, use of break and default with switch, program loops and iterations: use of while, do while and for loops, multiple loop variables, use of break, continue and goto statements.

Functions: Introduction, types of functions, functions with array, passing values to functions, recursive functions.

Unit -4

8L

Arrays: Array notation and representation, manipulating array elements using one and two dimensional arrays, linear searching, sorting (bubble sort), strings, matrix manipulation (transpose, addition, multiplication).

Structures: Purpose and uses of structures, declaring structures, array of structures, union, enumerated data types

Unit -5

8L

Pointers: Pointers: pointer variables, pointer operator, pointer expression, array of pointers, multiple indirection, pointers to functions, dynamic memory allocation functions.

File handling, standard C preprocessors, defining and calling macros, conditional compilation.

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LEARNING OUTCOMES

At the end of the course the students shall be able to:

- The basics of computer components & computer software.
- The basic terminology used in computer programming.
- To write, compile and debug programs in C language.
- Use different data types in a computer program.
- To design programs involving decision structures, loops and functions.
- To explain the difference between call by value and call by reference
- The dynamics of memory by the use of pointer.
- To use & understanding of file handling

Text Books:

1. Yashwant Kanetkar, “Let us C”, BPB Publications, 2nd Edition, 2001.
2. Stephen Prata “C Primer Plus” Addison-Wesley/Pearson 6th Edition 2014
3. P.K. Sinha “Computer Fundamentals” B.P.B Publication.

Reference Books:

1. Kernighan & Ritchie, “C Programming Language”, (Ansi C Version), PHI, 2nd Edition.
2. Byron Gottfreid “Schaum's Outline of Programming with C”.

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Subject Code	ME104	Subject Title	Workshop Practice						
LTP	0-0-2	Credit	1.0	Subject Category	UC	Year	1 st	Semester	I/II

Course Objective:

To identify hand tools and instruments for machining and other workshop practices. To obtain basic skills in the trades of fitting, carpentry, welding, sheet metal and machining. Introduction to Foundry, Forging shop, Gas & Spot Welding Acquire measuring skills, using standard workshop instruments & tools.

List of Experiments

- Carpentry:** To make a wooden joint with soft wood as per the drawing provided in the manual. (One of the following jobs)
Jobs: T-Lap joint, Dove tail joint, Mortise & Tendon joint, bridle joint. (4 Hrs)
- Arc Welding:** To make a welding joint with mild steel flat using Manual Metal Arc Welding Machine according to the drawing provided in the manual. (One of the following jobs)
Jobs: Lap joint, Butt joint, Fillet/Corner joint. (4 Hrs)
- Fitting:** To make a joint using fitting tools with mild steel flats, round bars or square bars as per the drawing provided in the manual. (One of the following jobs)
Jobs: Plug and socket joint with MS Plate, Square key with MS bar, External threads on GI pipes, Internal threading on MS flats. (4 Hrs)
- Machining:** To make a machine- component using lathe with mild steel round bar or hexagonal bar comprising common turning operations with reference to the drawing given in the manual. (One of the following jobs)
Jobs: Hex Bolt, Axle for cycle wheel, Jig Bush, a typical turning specimen. (4 Hrs)
- Sheet metal:** To make a sheet metal component with galvanized iron sheet as per the drawing provided in the manual having spot welded joint. (One of the following jobs)
Jobs: Square tray, Scoop, Funnel. (4 Hrs)
- Foundry & Forging shop:** To observe the demonstration of making a square key using hand forging tools & study the concept and application of Foundry. (2 Hrs)
- Gas & Spot Welding:** To observe the demonstration of making a Lap joint/Butt joint with mild steel sheet using Oxyacetylene flame as per the drawing provided in the manual & to perform the spot welding operation on G.I. sheet. (2 Hrs)
- Minor Project:** To make a minor project by the students in batches. (2 Hrs)

Learning Outcomes:

- Capability to identify hand tools and instruments for machining and other workshop practices.
- Obtain basic skills in the trades of fitting, carpentry, welding and machining.
- Acquire measuring skills, using standard workshop instruments & tools.
- Gain eye hand coordination, enhance psycho motor skills and attitude.

Text Book:

- H. Chaudhary, "Elements of Workshop Technology Volume 1 & 2", Media promoters & Publishers Pvt. Ltd. 14ed. (2017)

Reference Books:

- B.S. Raghuwanshi, "A course in Workshop technology Volume 1 & 2", Dhanpat Rai & Co, 10th ed
- W.A.J. Chapman, "Workshop Technology Part 1, Part 2 & Part 3", CBS Publishers & Distributors Pvt. Ltd.

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Subject Code	EE101	Subject Title	Introduction to Electrical and Electronics Engineering						
LTP	3-1-2	Credit	4.5	Subject Category	UC	Year	1 st	Semester	I/II

OBJECTIVES

- To acknowledge students about charge, current, voltage and various circuit laws involved in analysis.
- To get acquaints students with the basic idea of Generation, Transmission and Distribution of Electrical energy.
- To provide students with the basic knowledge of operation and working different types of electrical machines and their application
- To provides knowledge regarding use of multiphase system and their possible interconnections with different loads.

To get acquaints student with fundamental knowledge of semiconductor devices their characteristics and modelling in different applications.

UNIT I – DC NETWORK THEOREM

Review of basic circuit theory concepts, Mesh and Nodal analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Star – Delta transformation

UNIT II – AC CIRCUIT'S FUNDAMENTAL AND TRANSFORMERS

Single Phase AC: Phasor representation of voltage and current, AC circuit behaviour of Resistive, Inductive and Capacitive Load and their combination in series and parallel, Power triangle, Power factor
Three Phase AC: Delta and Star connections, Relation between Line and Phase values, three phase power and its measurement

Transformers: Principle of power Generation (single line diagram), Principle of Operation, Types of construction

UNIT III – ELECTRICAL MACHINES

DC Machines: Construction, working principle & characteristics

Three Phase Induction Machines: Principle of operation of 3 ϕ Induction Motor, Types of Induction Motor, need for starter in 3 ϕ IM, Slip- Torque characteristics.

Single Phase Induction Motor: Principle of operation of 1 ϕ IM, Methods of starting of 1 ϕ IM

Synchronous Machines: Construction and Principle of operation of Alternator and Synchronous Motor

UNIT IV: FUNDAMENTAL OF SEMICONDUCTOR: Energy bands in semiconductors, intrinsic and extrinsic semiconductors, Fermi level.

Diode circuits: Construction, Junction diode characteristics, Half and full wave rectifiers - Expression for efficiency and ripple factor, Filter circuits. Zener Diode Characteristics and its application as voltage regulator in Regulated power supply.

UNIT V: TRANSISTOR FUNDAMENTAL:

Transistor circuits: Construction and characteristics of a transistor in CB, CE and CC modes - Relative merits. Load Line and operating point concept (both AC and DC). Biasing of Transistors and stability analysis. Construction and characteristics of JFET and MOSFET.

Communication Systems, Communication Channels, Need of modulation, Types of modulations (Wave shapes and final expression only),

Text Books

1. Vincent Del Toro, "Principles of Electrical Engineering", Prentice Hall Publication.
2. I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill Publication.
3. Electronics Devices and Circuits, Millman and Halkias, Tata McGraw Hill, 4th ed.
4. Electronic Communication Systems, John Kennedy, Tata McGraw Hill, 4th ed.

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Electrical and Electronics Lab:

1. Verification of Network Theorems.
2. Measurement of efficiency of a single phase transformer by load test.
3. Determination of parameters and losses in a single phase transformer by OC and SC test.
4. Perform the polarity test on Transformer.
5. Study of characteristic of AC Motor.
6. Study of DC shunt and series generator characteristics.
7. Study the Speed control of dc shunt motor.
8. Study running and reversing of a three phase induction motor.
9. To identify and Study of the various component and Devices of electronics with their specification (CRO, Function Generator, Multimeter, Power Supply, resistor, capacitor, inductor, ICs, LED, potentiometer etc.)
10. To study the V-I characteristics of PN diode and Zener diode.
11. To find the efficiency of rectifiers and ripple factor of capacitive and non-capacitive half wave and full wave rectifier.
12. To Study and verify clipper and clamper with biased circuits.
13. To find the characteristics of CB and CE amplifiers.
14. Determine the characteristics of FET.
15. To find out the power energy of various periodic and non-periodic signals.

LEARNING OUTCOMES

1. Acknowledge students about charge, current, voltage and various basic electric circuit laws.
2. Acquaint students about DC circuit analysis and methods.
3. Advanced approach for solving series parallel network of resistors by star delta transformation.
4. Basics of AC circuits elements and various methods involved. Understanding the concepts of rms, average and peak values of AC waveforms and their power factor.
5. Acquaint students about the three phase loads, star delta connections and power. Relation between there phase and line values.
6. Acknowledge students with the use of transformers and its working.
7. To build an ability amongst students regarding the functioning of DC machines and its characteristics.
8. To recognise the need for synchronous machine in our electrical systems, its basic functioning and various advantages over other types of machines.
9. Provide students' knowledge regarding construction and working of three phase and single phase induction motors their application in various practical applications.
10. Provides information regarding the fundamental theory of semiconductor devices, fermi level and concept of doping.
11. Acquaints students with the knowledge of different types diode circuit configuration.
12. Provide students with the capability of analysing the different types of waveforms and to calculate various associated parameters.
13. Basics of different types of transistor configuration, modelling and their application.
14. Basics of communication system, modulation and their types

Text Books

5. Vincent Del Toro, "Principles of Electrical Engineering", Prentice Hall Publication.
6. I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill Publication.
7. Electronics Devices and Circuits, Millman and Halkias, Tata McGraw Hill, 4th ed.
8. Electronic Communication Systems, John Kennedy , Tata McGraw Hill, 4th ed.

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Subject Code	EE102	Subject Title	Electrical & Electronics Measurements						
LTP	1-0-2	Credit	2.0	Subject Category	UC	Year	1 st	Semester	I/II

OBJECTIVES

- To get Acquaints students with the basic idea of measurement system, its classification and characteristics.
- To acknowledge students about different types of measuring instruments based on the fundamental principle.
- To provide students with knowledge of methods of measuring resistances, inductance and capacitance.
- To provides knowledge regarding the basics of digital Measurement

Philosophy of Measurement:

Methods of Measurement, Measurement System, Classification of instrument system, Characteristics of instruments & measurement system, Errors in measurement & its analysis, Standards.

Analog Measurement of Electrical Quantities:

Permanent Magnet Moving Coil, Moving Iron type of Ammeters & Voltmeters, Electrodynamic Wattmeter,

Measurement of Parameters: Different methods of measuring low, medium and high Resistances, measurement of Inductance & Capacitance with the help of AC Bridges.

Digital Measurement:

Concept of digital measurement, Block diagram.

LEARNING OUTCOMES

1. Acknowledge students with the methods of measurement, classification of instruments system.
2. Acquaint students about characteristics of instruments and their operation.
3. Provides knowledge about basics of error measurement and methods of reducing it.
4. Basics of different types of measuring instruments based on the fundamental theory of operation.
5. Acknowledge students with the methods of measuring low, medium and high resistance.
6. Acknowledge students with the methods of measuring inductance and capacitance using different bridge configuration.
7. Provides knowledge regarding the fundamental of digital measurement, techniques and its application.

Text Book:

1. E.W. Golding & F.C. Widdis, "Electrical Measurement & Measuring Instrument", A.W. Wheeler & Co. Pvt. Ltd. India.
2. A.K. Sawhney, "Electrical & Electronic Measurement & Instrument", Dhanpat Rai & Sons, India.

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Electrical and Electronics Measurement (Labs)

1. Calibration of ac voltmeter and ac ammeter.
2. Measurement of form factor of a rectified sine wave and determine source of error if r.m.s. value is measured by a multi-meter.
3. Measurement of phase difference and frequency of a sinusoidal ac voltage using C.R.O.
4. Measurement of power and power factor of a single phase inductive load and to study the effect of capacitance connected across the load on the power factor.
5. Measurement of low resistance by Kelvin's double bridge.
6. Measurement of voltage, current and resistance using dc potentiometer.
7. Measurement of inductance by Maxwell's bridge.
8. Measurement of inductance by Hay's bridge.
9. Measurement of inductance by Anderson's bridge.
10. Measurement of capacitance by Owen's bridge.
11. Measurement of capacitance by De Sauty Bridge.
12. Measurement of capacitance by Schering Bridge.
13. Study of A to D convertor and its realization.
14. Study of D to A convertor and its realization.

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Subject Code	MA102	Subject Title	Engineering Mathematics-II						
LTP	3-1-0	Credit	3.5	Subject Category	UC	Year	1 st	Semester	I/II

OBJECTIVE: To introduce the fundamentals in Matrices and Linear Algebra, Ordinary Differential Equations, Infinite Series, Laplace Transform and Fourier Series relevant to engineering applications.

UNIT I: Linear Algebra

Matrices, Elementary row and column operations, row reduced echelon form, rank of a matrix, invertible matrices. Consistency and solution of a system of linear equations. Properties of R^n as a vector space, Linear Dependence and Independence of elements in R^n , Basis of a Vector Space, Vector Space of polynomials over R and its basis, Matrix transformation, Rank-Nullity Theorem, Similar Matrices, Eigen-values and Eigen-vectors, Cayley–Hamilton theorem and its applications. Diagonalization of Matrices.

UNIT II: Differential Equations

Methods of solving differential equations of first order and first degree, Bernoulli equation, Solutions of linear differential Equations of second and higher orders with constant & variable coefficients, Euler-Cauchy linear differential equation, method of variation of parameters. Solution of simultaneous linear differential equations.

UNIT III: Infinite Series

Introduction; Sequences; Series; Convergence; Series of positive terms; Comparison test; Integral test; D'Alembert's Ratio test; Cauchy's root test; Alternating series; Leibnitz rule.

UNIT IV: Fourier Series

Periodic functions; Fourier series of Periodic functions; Euler's formulae; Functions having arbitrary period; Change of intervals; Even and Odd functions; Half range sine and cosine series.

UNIT V: Laplace Transform

Laplace Transform; Existence theorem; Properties of Laplace Transform ; Laplace Transform of derivatives and integrals; Laplace Transform of Periodic functions; Unit Step function and Error Function; Dirac- Delta function. Inverse Laplace Transform and their properties, Convolution theorem; Applications of Laplace Transform to solve linear and simultaneous differential equations pertaining to engineering problems.

Outcome: Familiarity with fundamental tools of Matrices and Linear Algebra, Ordinary Differential Equations, Infinite Series, Laplace Transforms and Fourier Series relevant to engineering applications

Text Books:

- 1.R. K. Jain & S. R. K. Iyenger, Advanced Engineering Mathematics, 2nd Edition, Narosa Publishing House, New Delhi, India, 2006.

Reference Books:

- 1.W. E. Boyce and R. Di Prima, Elementary Differential Equations, (8th Edition), John Wiley & Sons, U.K., (2005).
- 2.B. S. Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publication, New Delhi, India, 2012
- 3.E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, U.K., 2006.

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Applicable for 2017-2021

Subject Code	HS102	Subject Title	Corporate Communication and Soft Skills						
LTP	2-1-1	Credit	3.0	Subject Category	UC	Year	1 st	Semester	I/II

OBJECTIVES

- To introduce to students to the business & corporate environment and its expectations.
- To help students to identify and sharpen their personal and professional skills.
- To ensure employability of students through a perfect blend of hard & soft skills.

Unit I-Business Communication 10 hrs

Importance & Features of Business Communication, Flow of Communication: Channels & Networks

Communication: E mails & E- Tools

Business Presentation

Business Etiquette, Telephonic Etiquette

Business Letter Writing

Job Application Letter & Resume

Interview Skills, Impression Management:

Unit II-Personal Skills for Corporate Communication

10 hrs

SWOT Analysis: Self-Assessment, Identifying Strength & Weakness

Self-Awareness, Self-Disclosure & Self-Management (Stress, Anger)

Goal Setting: Personal & Professional Goals, SMART-ER Goals

Human Perception: Understanding People, Perceptions, Attitudes

Personality (Personality Test)

Unit III-Professional Skills for Corporate Communication

10 hrs

Decision Making: Techniques, Six Thinking Hats

Creative Thinking, Lateral Thinking

Team Building & Leadership Skills

Time Management: Planning Organizing, Time Wasters

Conflict Resolution Skills

Negotiation Skills

LEARNING OUTCOMES

- Students identify their goals and through enhanced soft skills work towards achieving them.
- Greater self-confidence and knowledge of life skills helps them to develop healthier interpersonal relationships.
- Prepares the students to face future challenges and excel in their personal and professional lives.

TEXT BOOKS

1. Rizvi, Ashraf. Effective Technical Communication, McGraw Hill, New Delhi. 2005.

REFERENCE BOOKS

1. The Seven Habits of Highly Effective People by Steven R. Covey. 2007.
2. How to win Friends and influence People by Dale Carnegie. 2009.
3. Soft Skills: Know Yourself & Know the World by Dr. Alex . S. Chand Publications 2001.
4. The ACE of Soft Skills: Attitude, Communication and Etiquette for Success by Gopalswamy Ramesh. 2008.
5. Managing Soft skills for Personality development by B. N Ghosh. 2006.
6. Personality Development by Elizabeth B. Hurlock. TMH Publication. 2010.

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Applicable for 2017-2021

Subject Code	CS102	Subject Title	Computer Programming in C++						
LTP	3-0-2	Credit	4.0	Subject Category	UC	Year	1 st	Semester	I/II

OBJECTIVE

To introduce object oriented programming concepts and implement them in C++.

Unit -1

8L

Introduction to Object Oriented Programming, including methodologies, programming techniques, Object Oriented languages.

Overview of C++ basic structures, including the main () function, C++ data types, different type of operators expressions and statements, standard Input/output, Simple flow of control, Defining user defined Functions.

Unit -2

8L

General overview of objects and classes, Object and classes in C++, including class definition, Defining members inside or outside, accessing of members, constructors, types of constructors, destructors and Pointer to class object.

Unit-3

8L

Polymorphism: function overloading, methods of overloading, constructor overloading, Operator overloading.

General overview of inheritance: Introduction, Categories of inheritance, public/protected/private inheritance, constructors and destructors in derived classes, and Virtual Base class.

Unit-4

8L

Function overriding and virtual functions, Abstract class and abstract base class, Friend functions, Templates in C++, function templates, class templates, templates and inheritances, templates and static members.

Unit-5

8L

File handing in C++: opening of file, closing of file, text files, binary files, Reading and writing into a file. Exception Handling in C++, including usage, try, throw and catch.

LEARNING OUTCOMES

At the end of the course the students shall be able to:

- Differentiate between procedure oriented programming and object oriented programming.
- Understand the three key features of the object-oriented programming language: encapsulation (abstraction), inheritance, and polymorphism.
- Know the benefits of object oriented programming.
- Identify the differences between private, public and protected members of a class.
- Declare and use static data members and static methods.
- Design and use friend functions and friend classes.
- Use constructor and destructor functions to initialize and destroy class objects.
- Use inheritance to build class hierarchies.
- Overload operators to work with user-defined classes.
- Implement programs for file Handling.
- Identify benefits of using virtual functions.

Text Books-

1. Kip R. Irvine, C++ and Object Oriented Programming, Prentice hall, 1997
2. R. Lafore, Object Oriented Programming using C++, BPB publications, 2004
3. E Balaguruswamy, Object Oriented Programming with C++, TMH 2nd edition

Reference Books-

1. Schildt Herbert, C++ Programming, 2nd edition, Wiley
2. Yashwant Kanethkar, Object Oriented Programming using C++, BPB, 2004

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Subject Code	ME101	Subject Title	Engineering Mechanics						
LTP	3-1-0	Credit	3.5	Subject Category	UC	Year	1 st	Semester	I/II

Course Objective:

The objective of this course is to make students to learn basic engineering mechanics concepts and will help in solving problems involving forces, loads and moments and to know their applications in allied subjects. The course will develop engineering aptitude in field of application of science and technology.

Unit 1: Introduction to Engineering Mechanics

Introduction: Idealization of bodies, physical quantities- units and dimensions, Scalars and vectors, Laws of mechanics, system of forces and its classification, Principle of superposition, transmissibility of forces.
(2 Hrs)

Resultant of concurrent force system

Parallelogram Law of forces, Resolution of forces, Principle of resolved parts; Numerical problems on composition of coplanar concurrent force systems.
(2 Hrs)

Resultant of non-concurrent force system :

Moment of a force, Couple, Equivalent force - couple system, Numerical problems on resultant of non-concurrent force system.
(3 Hrs)

Unit 2: Equilibrium and Friction

Equilibrium of system of forces - Definition of Equilibrant; Free body diagram, Equilibrium of two and three force system, Conditions of static equilibrium, Lami's theorem.
(3 Hrs)

Application- Static Friction in rigid bodies in contact

Types of friction, Laws of static friction, Limiting friction, Angle of friction, angle of repose; Impending motion on horizontal and inclined planes; Numerical Problems on single and two blocks on inclined planes, ladder and wedge friction.
(4 Hrs)

Unit 3: Analysis of Plane truss and Beam

Support Reaction in beams: Types of beams, Types of Loads and Supports, statically determinate beams, Numerical problems on support reactions for statically determinate beams with Point load (Normal and inclined) and uniformly distributed and uniformly varying loads and Moments.
(3 Hrs)

Plane Truss: Perfect and imperfect truss Assumptions and Analysis of Plane Truss by Method of joints and Method of section.
(4 Hrs)

Unit 4: Centroids and Moments of Inertia of Engineering Sections

Centroids: Introduction to the concept, Centroids of line and area, Centroids of basic geometrical figures, computing Centroids for regular and composite cross-sections. (4 Hrs)

Moment of Inertia : Introduction to the concept, Radius of gyration, Parallel axis theorem, Perpendicular axis theorem, Moment of Inertia of basic planar figures, computing moment of Inertia for regular and composite cross-sections.
(4 Hrs)

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Unit 5: Kinematics and kinetics

Kinematics of particles: Motion related to Cartesian and polar coordinates, motion curves, relative motion and dependent motion. Projectile motion, tangential and normal components of acceleration.

(4 Hrs)

Kinetics of particles: Newton's second law of Motion; Energy principles; Impulse momentum principle; direct central impact.

(3 Hrs)

LEARNING OUTCOMES

1. Identify principles of mechanics used in real life engineering problems.
2. Know basics of Engineering based on force application, and selection of materials in application.
3. Understand the action of Forces, Moments and other loads on systems of rigid bodies;
4. Compute the reactive forces and the effects that develop as a result of the external loads;
5. Locate the Centroids and compute the Moment of Inertia of regular cross-sections.
6. Express the relationship between the motions of bodies
7. Equipped to pursue studies in allied courses in Mechanics.

Text Books:

1. A. Nelson, "Engineering Mechanics: Statics & Dynamics", Tata McGraw-Hill Education Pvt. Ltd., New Delhi, 1st edition, 2009.Reprint 2016
2. S.S. Bhavikatti, "Engineering Mechanics", New Age International Publishers Ltd., New Delhi, 3rd edition, SI Metric 2009.

Reference Books:

1. S. Timoshenko, D.H. Young, J.V. Rao and S. Pati, "Engineering Mechanics", TATA McGraw-Hill Education, New Delhi, 5th edition, 2013.
2. F.P. Beer and E.R. Johnson, "Mechanics for Engineers- Dynamics and Statics", Tata McGraw-Hill, 3rd SI Metric edition, 2008.
3. I.H. Shames and G.K.M. Rao, "Engineering Mechanics: Statics & Dynamics", Pearson Education India, 4th edition, 2005.
4. A.R. Basu, "A Text book of Engineering Mechanics", Dhanpat Rai & Co.(P) Ltd., 2003.

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Subject Code	ME102	Subject Title	Mechanical Measurements						
LTP	1-0-2	Credit	2.0	Subject Category	UC	Year	1 st	Semester	I/II

Course Objective:

To educate students on different measurement systems and to share application of principle of metrology and measurements as applied in industries. To learn laboratory skills, conduct experiments and identify sources of variability.

Measurement-Basics:

Unit & Dimension, Traceability, Calibration, Least count, Error, Accuracy, Precision, Uncertainty, Repeatability, Reproducibility and Steadiness.

Measurement - Solids:

Inside / Outside Diameter, Height / Depth, Eccentricity / Run-out, Taper, Backlash (play), Thermal conductivity

Measurement - Material Properties:

Metals, Non-metals & Polymers, Measurement of mechanical properties as Tensile strength, Impact Strength and Hardness, Mass Moment of Inertia of rigid body and Poission's Ratio.

Measurement - Fluids:

Density, Specific Gravity, Specific volume, Surface Tension & Viscosity Measurement, open channel discharge & velocity measurement, Heat Engine and Heat exchanger.

List of Experiments

1. Error Analysis and Graph drawing and Evaluation.
2. Measurement of inside & outside diameter, taper, run-out etc.
3. Measurement of thermal conductivity of a material.
4. Tensile test.
5. Impact test.
6. Hardness test.
7. Measurement of Mass Moment of Inertia of rigid body.
8. Measurement of Poission's ratio.
9. Surface tension & viscosity measurement.
10. Open channel simple techniques flow measurement.
11. Others

LEARNING OUTCOMES

- Demonstrate excellent laboratory skills, conduct experiments and Identify sources of variability
- Analyse, interpret, and present measurement data from measurements/experiments
- Enhance ability to apply knowledge of mathematics, statics, physics and engineering sciences
- Gain eye hand coordination, enhance psycho motor skills and attitude.

Text Books

1. B.C. Nakra and K.K. Chaudhry, "Instrumentation, Measurement and Analysis", Tata McGraw-Hill Pvt. Ltd., New Delhi, 5th edition, 2015.
2. E.O. Doebelin and D.N. Manik, "Doebelin's Measurement Systems", McGraw Hill Education, 6th ed

Lab Manual

1. DIT Engineering Measurements Lab Manual, ME Department Aug 2017

Reference Books:

1. SP Venkateshan IIT Madras, Mechanical Measurements 2nd Edition; e-Book,
2. NPLaboratory, Beginners guide to measurements in Mech Engineering, UK; e-Book

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Subject Code	ME103	Subject Title	Engineering Graphics						
LTP	0-0-3	Credit	1.5	Subject Category	UC	Year	1 st	Semester	I/II

Course Objective:

To improve the visualization skills and to develop an understanding of the theory of projection. To enable the students with various concepts like dimensioning, conventions and standards related to working drawings in order to become professionally efficient.

Contents:

- 1. Introduction:** Importance of graphics in engineering applications, Sheet Layout, Size of Sheets, Title blocks, Type of lines, Lettering, Dimensioning, Scale (Full, Reduced, Large)
- 2. Projection:** Methods of Projection, Planes of Projection, Projection of points, Projection of straight lines, Projection of planes.
- 3. Projection:** Projection of solids.
- 4. Orthographic views:** Machine parts with dimensioning.
- 5. Freehand sketching:** Isometric Projections; Introduction and basics.
- 6. AutoCAD:** Introduction to Commands, Explaining need of AutoCAD over Manual drafting.

Mode: The contents of the subject needs to be delivered in the form of basic teaching process in one hour of the three hours practice session , such that the student is able to understand the basic principles before initiating drawings.

Exam: Engg Graphics will have both Mid Term and End Term Practical Exams

Learning Outcomes:

- To enable students to acquire and use engineering drawing skills as a means of accurately and clearly communicating ideas, information and instructions.
- To enable students to acquire requisite knowledge, techniques and attitude required for advanced study of engineering drawing.
- Understand AutoCAD commands and appreciate the need of AutoCAD over Manual Drafting.

Text Books:

- 1) N. D. Bhatt and V.M. Panchal, “Engineering Drawing”, Charotar Publishing House Pvt. Ltd., 53rd edition, 2016 reprint.
- 2) P.S. Gill, “Engineering graphics”, S. K. Kataria & Sons, 13th edition, 2016.

Reference Books:

- 1) D.A. Jolhe, “Engineering Drawing”, Tata McGraw-Hill Education Pvt. Ltd., 1st edition, 2008.
- 2) K.C. John, “Engineering graphics”, PHI Learning Pvt. Ltd., 2nd edition, 2010.
- 3) F.E. Giesecke, A. Mitchell, H.C. Spencer, I.L. Hill, J.T. Dygdon, J.E. Novak, “Technical Drawing”, Prentice Hall, 12th edition, 2003

List of Experiments/ Drawing sheets (L+P)

- | | |
|---|-----------|
| 1. One sheet on Lettering and Geometric construction. | (1+4 Hrs) |
| 2. One sheet on Basics of Projection of points and lines. | (2+4 Hrs) |
| 3. One sheet on Projection of Planes. | (2+4 Hrs) |
| 4. One sheet on Projection of Solids. | (2+4 Hrs) |
| 5. One sheet on Orthographic views of simple isometric blocks. | (1+4 Hrs) |
| 6. One sheet on Free hand sketches and Basic Isometric Projections. | (0+4 Hrs) |
| 7. Basic AutoCAD commands. | (1 +3Hrs) |

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Subject Code	CH101	Subject Title	Engineering Chemistry						
LTP	3-1-2	Credit	4.5	Subject Category	UC	Year	1 st	Semester	I/II

OBJECTIVE: To provide a summary on water chemistry, water treatment, green chemistry and synthetic chemistry. The course intends to provide an overview of the working principles, mechanism of reactions and application of the building blocks like batteries, fuel cells, polymers and an overview of surface coatings in order to protect the metal. This course relies on elementary knowledge of polymers, engineering materials and basics of nanotechnology to illustrate the concepts involved. To provide an impression of organic chemistry, spectroscopy, biomolecules, fuels and lubricants. To gain the knowledge on existing & future upcoming devices, materials and methodology.

Unit 1. Water Treatment and Analysis

(08 Lectures)

Standards for drinking water, Water Quality parameters, Determination of alkalinity of water, Hardness of water: Units and determination. Demineralization of water, Softening of water: Limesoda Process, Ion exchange process, Zeolite process and RO process. Internal conditioning methods: Carbonate conditioning, Phosphate conditioning, Colloidal conditioning, Calgon conditioning. Desalination of brackish water.

Unit 2. Electrochemistry & Corrosion

(06 Lectures)

Migration of ions, Transference number, Determination of Transference number by Hittorf's method, Conductometric titrations, Types of electrode: Calomel and glass electrode, Liquid junction potential, Potentiometric Titrations, Corrosion and its economical aspects, Types of corrosion: Galvanic, Erosion, Crevice, Pitting, Waterline, Soil, Microbiological. Theories of corrosion: Acid, Direct Chemical attack, Electrochemical. Corrosion prevention by metallic, organic/inorganic coatings and corrosion inhibitors

Unit 3. Polymers & Biomolecules

(10 Lectures)

Introduction; Classification of Polymers; Functionality; Mechanism of Polymerization; Plastics; Individual Polymers; LDPE, HDPE, PVC, Polystyrene, Bakelite, Teflon, PMMA, PET, Nylon-6, Rubbers (BUNA-S and BUNA-N); Speciality Polymers (Conducting Polymers, Silicones and Polycarbonates), Gypsum, Plaster of Paris, Insulating Materials. Structural and functional attributes of cell and cell organelles; Biomolecules (Proteins, Carbohydrates, Lipids, Enzymes, Nucleic acids). r-DNA technology and its applications in industry, health, environment and agriculture. Microbial technology and its common applications.

Unit 4. Fuels, Battery & Lubrication

(08 Lectures)

Classification of fuels, Calorific value, Cetane number, Octane number, fuel quality, Comparison of solid, liquid and gaseous fuel, properties of fuel, alternative fuels: Biofuels, Power alcohol and synthetic petrol, Battery, Photovoltaic cell, Metal-air battery, Lithium and nickel battery. Introduction of Lubricants, Functions of Lubricants, Classification of lubricants, Mechanisms of Lubrication, Properties of Lubricants.

Unit 5. Green Chemistry & Nano Chemistry

(08 Lectures)

Emergence of green chemistry, Twelve principle of green chemistry, use of alternative feedstock (biofuels), Use of innocuous reagents, use of alternative solvents, design of safer chemicals, designing alternative reaction methodology, minimizing energy consumption. Introduction to Nano chemistry, properties of Nanomaterials, preparation of nanomaterial, self-assembly, Nanomaterials, Applications of Nanomaterials

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LIST OF PRACTICALS

1. Determination of alkalinity in the given water sample.
2. Estimation of temporary and permanent hardness in water sample using EDTA as standard solution.
3. Calculation of percentage of available chlorine in bleaching powder.
4. Chloride content in the given water sample by Mohr's method.
5. Determination of iron content in the given ore by using external indicator
6. pH-metric titration.
7. Proximate Analysis of coal sample
8. Conductometric titration.
9. Synthesis of Phenol formaldehyde resin
10. Viscosity of a lubricant by Redwood Viscometer
11. Flash and Fire point determination of a Lubricant
12. Calorific value of a fuel sample by Bomb calorimeter.
13. Determination of order of reaction in ester hydrolysis reaction
14. To determine the DO in a given water sample
15. To study the adsorption of acetic acid on activated charcoal

LEARNING OUTCOME: Ability to know and to understand the various process of removing the hardness of water and principles of green chemistry. Understand the operating principles and the reaction mechanisms of batteries and fuel cells. Students will be able to apply this knowledge to the analysis and design of batteries. Hydrogen fuel cell technology is used in automobiles in order to reduce environmental pollution. Electrochemistry concept is used to know the Corrosion treatment process of alloys. An ability to identify and formulate polymers and have a knowledge of various polymers like polyethylene, PVC, PS, Teflon, Bakelite, Nylon which have engineering applications. To gain acquaintance regarding biomolecules and their application in engineering. An ability to handle various instruments like spectroscope, flame photometer etc. Have a knowledge of synthesizing Nano materials and their applications in industry. Know the properties of Fuels and Lubricants. Have a scope in the area of Material Chemistry.

Text Books Recommended:

1. Engineering Chemistry by Shikha Agarwal. Cambridge University Press Edition 2015.
2. Engineering Chemistry by S. Vairam & Suba Ramesh. Wiley India Pvt. Ltd. 2014.

Reference Books:

1. Environmental Chemistry by Stanley E. Manahan. CRC Press Taylor and Francis.
3. Organic Chemistry by Morrison and Boyd. Pearson.
4. Physical Chemistry by Atkins. Oxford University Press.
5. Concise Inorganic Chemistry by J.D. Lee. Oxford University Press.
6. Basic Biotechnology by S Ignacimuthu. Tata Mcgraw-Hills
7. Spectroscopy by Silver Stein. Pearson.
8. Nano: The essentials by T. Pradeep. McGraw Hill Education.
9. Biochemistry by Stryer Lubert. Mcmillan learning. 2015.

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Subject Code	CH201	Subject Title	Environmental Science						
LTP	2-0-0	Credit	0	Subject Category	AC	Year	2 nd	Semester	3 rd

Course Outline:

Course Objective:

To impart basic knowledge about the environment and its allied problems and to develop an attitude of concern for the environment. Further the course structure will create the awareness about environmental problems among students and motivate the students to participate in environment protection and environment improvement programs. The course aims to develop skills to help the concerned individuals in identifying and solving environmental problems.

Course Pre/Co- requisite (if any):

Detailed Syllabus

UNIT 1: Basics of Environment and Natural Resources

Definition and Concept of Environment, Multidisciplinary nature of environmental studies. Scope and importance of environmental studies, Need for public awareness, Environmental concerns and people. Introduction and classification of natural resources. Energy Resources, Water Resources, Land Resources, Forest Resources, Food Resources, Mineral Resources, Case studies related to over exploitation of resources and their impacts. Role of an individual in conservation of natural resources, Sustainable lifestyles.

UNIT 2: Ecosystems

Definition and concept of ecology, Structure and Function of an Ecosystem, Energy Flow in Ecosystems, Biogeochemical cycles (Nitrogen, Carbon, Phosphorus, Oxygen and Hydrological). Species interactions in ecosystems. Ecological succession and ecological pyramids. Characteristic features of grassland, pond, desert and forest ecosystems. Ecosystem services and conservation.

UNIT 3: Biodiversity and its conservation

Introduction and types of biodiversity. Bio-geographic classification of India, Value and significance of biodiversity, Biodiversity at global, national and local levels, India: A mega-diversity nation, Biodiversity hotspots, Threats to Biodiversity: Poaching and man-wildlife conflicts, IUCN Red Data Book and endangered & endemic species of India. Biodiversity conservation strategies, Institutes and organizations.

UNIT 4: Environmental Pollutions

Introduction and Definition. Causes, consequences and control measures of: Air pollution, Water pollution, Noise pollution, Nuclear pollution, Soil pollution, Thermal and Marine pollution. Solid waste management, Bio-medical waste management. Disasters and its mitigation strategies, Global warming, Climate change, Acid rain, Ozone depletion and Smog. Pollution case studies. Role of an individual in pollution prevention.

UNIT 5: Social Issues and Environment

Sustainable Development: Concept and importance, Environmental Impact Assessment (EIA), GIS, Remote sensing. Water conservation and rain water harvesting. Resettlement and rehabilitation problems, Environmental audit, eco-labeling and eco-friendly business. Environmental Legislation in India, Population explosion and its impact on environment and human health, Value Education and environmental ethics.

Field work

- Visit to a local area to document environmental asset: river/forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common flora and fauna.

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- Study of a common ecosystem-pond, river, hill slopes, etc.Learning Outcome

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

CO1. Demonstrate depleting nature of Environmental Resources and Ecosystem concepts.

CO2. Able to identify the structure and functioning of natural ecosystems.

CO3. Establish man-wildlife harmonious relationship.

CO4. Adapt to 3R (Reuse, Recovery, Recycle). Identify the causes and control measures related to Pollutions.

CO 5. Illustrate and analyse various Case Studies related to Environmental issues and Env. Legislation.

Text book [TB]:

1. Bharucha Erach, 2004. Textbook for Environmental Studies, University Grants Commission, New Delhi.
2. Kaushik A & Kaushik C P. 2007. Perspectives in Environmental Studies, New Age International Publ.
1. S. Deswal & A. Deswal 2015. A Basic Course in Environmental Studies. Dhanpat Rai & Co.

Reference books [RB]:

1. Miller T.G. Jr. 2002. Environmental Science, Wadsworth Publishing Co. (TB).
2. De A.K. 1996. Environmental Chemistry, Wiley Eastern Ltd.
3. Sharma, P.D. 2005. Ecology and environment, Rastogi Publication.

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Subject Code	HS244	Subject Title	Indian Constitution						
LTP	2-0-0	Credit	0	Subject Category	AC	Year	2 nd	Semester	3 rd

Course Outline:

Course Objective:

To familiarize the students with the features of the Indian Constitution
To provide a knowledge of their constitutional rights

Course Pre/Co- requisite (if any):

Detailed Syllabus

UNIT 1: Introduction

Constitution- meaning of the term, basic features Indian Constitution: Sources and constitutional history. Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive, Principles of State Policy, debates on Fundamental Rights and Directive

UNIT 2: Union Government and its Administration

Structure of the Indian Union: Federalism, Centre- State relationship. President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha. Institutional Functioning: Prime Minister, Parliament and Judiciary, Power Structure in India: Caste, class and patriarchy

UNIT 3: State Government and its Administration

Governor: Role and Position, CM and Council of ministers, State Secretariat: Organization, Structure and Functions

UNIT 4: Local Administration

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected, Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT 5: Election Commission

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women

Learning Outcome

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

CO1. Enable the students to protect their rights

CO2. The students will be engaged in the political system of India

Text book [TB]:

1. Abbas, H., Kumar, R. & Alam, M. A. (2011) Indian Government and Politics. New Delhi: Pearson, 2011.
2. Chandhoke, N. & Priyadarshi, P. (eds.) (2009) Contemporary India: Economy, Society, Politics. New Delhi: Pearson.

Reference books [RB]:

1. Chakravarty, B. & Pandey, K. P. (2006) Indian Government and Politics. New Delhi: Sage.
2. Chandra, B., Mukherjee, A. & Mukherjee, M. (2010) India After Independence. New Delhi: Penguin.
3. Singh, M.P. & Saxena, R. (2008) Indian Politics: Contemporary Issues and Concerns. New Delhi: PHI Learning.
4. Vanaik, A. & Bhargava, R. (eds.) (2010) Understanding Contemporary India: Critical Perspectives. New Delhi: Orient Blackswan.
5. Menon, N. and Nigam, A. (2007) Power and Contestation: India Since 1989. London: Zed Book.
6. Austin, G. (1999) Indian Constitution: Corner Stone of a Nation. New Delhi: Oxford University Press.
7. Austin, G. (2004) Working of a Democratic Constitution of India. New Delhi: Oxford University Press.
8. Jayal, N. G. & Maheta, P. B. (eds.) (2010) Oxford Companion to Indian Politics. New Delhi: Oxford University Press.

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Subject Code	MA201	Subject Title	Engineering Mathematics-III						
LTP	3-1-0	Credit	4	Subject Category	SC	Year	2 nd	Semester	3 rd

Course Outline:

Course Objective:

Introduce the fundamentals in Complex variable. Solving Partial Differential Equations. Legendre polynomial of first kind with properties. Bessel function of first kind and its properties.

Course Pre/Co- requisite (if any):

Detailed Syllabus

UNIT 1: Complex variable- I

Elementary functions, limit, continuity & differentiability, Analytic Functions; Cauchy – Riemann equations, Harmonic functions, Line integral in the complex plane, Cauchy's Integral theorem, Cauchy's Integral formula for derivatives of analytic function.

UNIT 2: Complex Variables -II

Power series, Taylor's series, Laurent's series, Poles, Zeros, Singularities, Residue Theorem, Evaluation of real

integrals of the type $\int_0^{2\pi} f(\cos \theta, \sin \theta) d\theta$ and $\int_{-\infty}^{\infty} f(x) dx$.

UNIT 3: Special Functions

Series solution of ODE of 2nd order with variable coefficient with special emphasis to Legendre and Bessel differential equation by Frobenius method, Legendre polynomial of first kind, Bessel function of first kind and their properties.

UNIT 4: Fourier Transform & Z-transform

Fourier integral, Fourier transform, Fourier sine and cosine transforms, Linearity, Scaling, frequency shifting and time shifting properties, Convolution theorem and its application.

Z – Transform, Properties of Z-transforms, Convolution of two sequences, Inverse Z-transform, Solution of difference equations.

UNIT 5: Partial differential equations and its Applications

Introduction to partial differential equations; Linear partial differential equations with constant coefficients of second order and their classification; Method of Separation of Variables for solving Partial Differential Equations, One-Dimensional Wave Equation, One Dimensional heat equation.

Learning Outcome

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

CO1. Familiarity with methods of solving partial differential equations.

CO2. Learn differentiation and Integration of complex functions.

CO3. Solving real integrals with complex integration.

CO4. Learn Fourier and Z-transform rules with applications.

Text book [TB]:

1. J.W. Brown & R. V. Churchill: Complex Variables & Applications, 9th edition, McGraw-Hill, 2013.
2. R. K. Jain & S. R. K. Iyenger, Advanced Engineering Mathematics, 2nd Edition, Narosa Publishing House, New Delhi, India, 2014.

Reference books [RB]:

1. B. S. Grewal, Higher Engineering Mathematics, 42th Edition, Khanna publication, New Delhi, India, 2012.
2. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, U.K., 2006.

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Subject Code	ME205	Subject Title	Thermodynamics and Heat Engines						
LTP	3-1-0	Credit	4	Subject Category	DC	Year	2 nd	Semester	3 rd

Course Outline:

Course Objective:

Learn energy interactions and balance of energy between system and its surroundings. Heat- Work concept and understand different governing laws of thermodynamics and their applications. Have concept of energy as low and high grade and its use in exergy analysis

Course Pre/Co- requisite (if any): Engineering Physics, Engineering Mathematics

Detailed Syllabus

UNIT 1: Introduction

Introduction, Engineering system of units, System and their properties, Concept of energy, Temperature, work and heat, Zeroth law of thermodynamics, Equation of state for an ideal gas

UNIT 2: First law of thermodynamics

First law of thermodynamics and engineering applications, Flow and non-flow processes, General energy equation for steady flow, Analysis of constant volume, constant pressure, isothermal and adiabatic processes, reversible and irreversible processes..

UNIT 3: Introduction to second law of thermodynamics

Introduction and definition of second law of thermodynamics, Carnot theorem, Definition and concept of entropy, Change of entropy for gas.

Pure substances, Phase diagrams, tabulated properties, Property charts and their use.

UNIT 4: Air standard cycles

Air standard cycles, Carnot cycle, Otto, Diesel, Dual cycles. I.C. Engines, Classification, Construction and working of two stroke and four stroke engines, S.I. and C.I. engines, Work output, Efficiency and mean effective pressure

UNIT 5: Combustion

Combustion in S.I. Engines, Combustion in C.I. Engines, Parameters; Heat Balance Sheet.

Learning Outcome

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

CO1: Apply energy balance to systems and control volumes, in situations involving heat and work interactions.

CO2: Evaluate performance of energy conversion devices by basics of air standard cycles

CO3: Evaluate changes in thermodynamic properties of pure substances.

CO4: Visualize and comprehend challenges in SI & CI Engines Combustion process

CO5: Understand and prepare a Heat balance Sheet

Text book [TB]:

1. Engineering Thermodynamics by P. K. Nag; 5th ed, 2016.
2. Internal combustion Engine, Mathur Sharma, Dhanpatrai publication 2016

Reference books [RB]:

1. Fundamentals of Thermodynamics by Van Wylen 2006
2. Thermodynamics: An Engineering Approach by Yunus A. Cengel and Michael A. Boles 2010
3. Engineering Thermodynamics by Gupta and Prakash. 2006

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Subject Code	ME202	Subject Title	Strength of Materials						
LTP	3-1-0	Credit	4	Subject Category	DC	Year	2 nd	Semester	3 rd

Course Outline:

Course Objective:

To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.

Course Pre/Co- requisite (if any): Engineering Mechanics

Detailed Syllabus

UNIT 1: Stresses and strains

Simple stress and Strain: Hooke's law; true and engineering stress -strain curves; , axial stress in varying cross sections, volumetric strain, relation between elastic constants, thermal stress and strain.

Compound stress and strains: Introduction; state of plane stress; stress on an inclined plane; Principal stresses and Principal planes; Mohr's stress circle.

UNIT 2: Properties of Sections & Stresses in Beams

Properties of Sections: Centre of gravity and moment of inertia of commonly used cross sections (T- section, I section, Channel section and circular and triangular section).

Stresses in Beams: Shear force and bending moment diagrams, bending stresses in beams; shear stresses in beams.

Torsion of circular shaft: Torsion equation; shafts in series and parallel.

Combined Stresses: Combined bending and torsion; Combined bending and axial thrust.

UNIT 3: Deflections of Beams & Strain Energy

Deflections of Beams: Introduction; differential equation of the deflected beam; (cantilever and simply supported beams) Macaulay's method; Moment area method, Castigliano's Theorem.

Strain energy: Concept and application.

UNIT 4: Columns, Struts and springs

Column and strut: Euler's theory of buckling of column for different end conditions; limitations of Euler's Formula; Rankine's Formula.

Springs: leaf springs, close coiled and open coiled helical springs with axial load. Springs in series and parallel

UNIT 5: Thin cylinders and Shells & Theories of failure

Thin cylinders and Shells: Hoop and axial stresses strain; volumetric strain. Joint efficiency.

Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal and external pressures.

Theories of failure: Application to two dimensional (plane stress) cases.

Learning Outcome

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

CO1: Recognize various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components

CO2: The students will be able to evaluate the strain and deformation that will result due to the elastic stresses developed within the materials for simple types of loading.

CO3: Calculate the elastic deformation occurring in various simple geometries for different types of loading

CO4: Evaluate equivalent stress with consideration of failure theories

Text book [TB]:

1. Strength of Materials by R.Subramaniam, Oxford University Press, New Delhi.2007
2. Strength of Materials by B.C. Punamia, Laxmi Publications.2015

Reference books [RB]:

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1. Gere J. M., Timoshenko S.P., Mechanics of materials, CBS Publication, 2nd edition, ISBN- 8123908946.
2. Popov Eger P., "Engg. Mechanics of solids", Prentice Hall, New Delhi, 2nd edition, ISBN- 0135713560.
3. Hibbeler R.C., "Mechanics of Materials", Prentice Hall, New Delhi, 9th edition, ISBN- 0133254429.
4. Fenner, Roger.T, "Mechanics of Solids", U.K. B.C. Publication, New Delhi 2001
5. Ferdinand P. Beer, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGrawHill Publishing Co. Ltd., New Delhi 2005

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Applicable for 2017-2021

Subject Code	ME203	Subject Title	Materials Engineering						
LTP	3-0-2	Credit	4	Subject Category	DC	Year	2 nd	Semester	3 rd

Course Outline:

Course Objective:

To study the fundamental principles underlying and connecting the structure, processing, properties, and performance of materials systems.

Course Pre/Co- requisite (if any): Engineering Mechanics

Detailed Syllabus

UNIT 1:

Crystal Structures: History Of Materials, Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress. Microstructure

UNIT 2:

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

UNIT 3:

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, paratatic, peritectoid and monotectic reactions.

Iron Iron-carbide phase diagram and micro-structural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

UNIT 4:

Various types of carbon steels, alloy steels and cast irons, its properties and uses. Diffusion: Introduction, diffusion mechanisms, Steady-state diffusion, factors that influence diffusion.

Heat Treatment: Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams.

UNIT 5:

Ceramics: Structure, types, properties and applications of ceramics. Rubber, Plastics: Various types of polymers/plastics and its applications. Mechanical behavior of plastics. Future of plastics. Other materials: Brief description of other material such as optical and thermal materials, concrete, Composite Materials and its uses. Brief introduction to Smart materials & Nano-materials and their potential applications.

Learning Outcome

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

CO1: Will apply knowledge of mathematics, science and engineering to materials.

CO2: Will design and conduct experiments to analyze and interpret material testing data.

CO3: Be able to design a process, identify microstructure, on engineering needs.

CO4: Learn to identify, formulate, and solve engineering problems.

CO5: Learn to use the experimental, analytical, statistical, and computational tools for engineering practice in the materials discipline.

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Text book [TB]:

1. W.D. Callister, Jr, -“Material Science & Engineering” Addition-Wesley Publication, 7th edition, 2007.
2. Er. R. K. Rajput, “Material Science, 3rd edition, KATSON BOOKS.2006

Reference books [RB]:

1. Van Vlack, “Elements of Material Science & Engineering”, 6th edition, John Wiley & Sons, 2010.
2. V. Raghvan “Material Science”, 5th edition, Prentice Hall, 2005.

List of Experiments:

1. Making a plastic mould for small metallic specimen.
2. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.
3. Grain size determination of a given specimen.
4. Comparative study of microstructures of different given specimens (mild steel, gray cast iron, brass, copper etc.)
5. Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.
6. Material identification of, say, 50 common items kept in a box.
7. Study of corrosion and its effects.
8. Study of microstructure of welded component and HAZ. Macro and Micro Examination.
9. Suitable experiment on Magnetic/ Electrical/ Electronic materials.

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Subject Code	ME204	Subject Title	Manufacturing Processes						
LTP	3-0-2	Credit	4	Subject Category	DC	Year	2 nd	Semester	3 rd

Course Outline:

Course Objective:

This course will give an introduction to concepts and technologies of the principal manufacturing processes utilized by industry – Primary, Secondary & Tertiary from a designer's viewpoint

Course Pre/Co- requisite (if any): Engineering Mechanics

Detailed Syllabus

UNIT 1: Conventional Manufacturing Process

Classification of Manufacturing Processes, Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses

UNIT 2: Forming Process

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending).

Presses and their classification Compound vs. Progressive die, Forging equipment and methods: hand, drop and die forging.

UNIT 3: Metal cutting

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

UNIT 4: Joining/fastening processes

Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Arc welding: Power sources and consumables. TIG & MIG processes and their parameters, Resistance welding-spot, seam projection friction welding etc. Defects in welds and their remedies, HAZ Adhesive bonding. Powder Metallurgy Introduction

UNIT 5: Unconventional Machining Processes

Study of Machining processes, Process parameters and relations: EDM, ECM, LBM, EBM, PAM, Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining. Additive manufacturing: Rapid prototyping and Rapid tooling.

Learning Outcome

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

CO1: Define casting processes and suggest manufacturing sequence for simple product shapes

CO2: Guide on process sequence of sheet metal operations like Draw, Punch, Bend etc

CO3: Define type, material and geometry of cutting tools.

CO4: Suggest different welding / joining process.

CO5: Discuss modern manufacturing processes like EDM, ECM, USM, LBM etc.

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Text book [TB]:

1. S. Kalpakjian and S. Schemid (2001), Manufacturing, Engineering and Technology, Addison Wesley
2. A. Ghosh and A. K. Malik (2010) Manufacturing Science, East West Press Private Limited New Delhi

Reference books [RB]:

1. MP Groover, “Fundamentals of Modern Manufacturig”, John Wiley & Sons 2002
2. PN Rao, “Manufacturing Technology”, Tata Mcgraw Hill, 2017

List of Experiments:

1. To perform experiment on punching, blanking and drawing operation on sheet metal.
2. Study of Composite Material.
3. To prepare a sheet metal product (square container).
4. Pipe bending Operation.
5. Experiment based upon rolling and extrusion operation.
6. Study of Jigs and fixtures.
7. To study and observe various stages of casting through demonstration of Sand Casting Process.
8. To make an S-hook from a given round rod, by following hand forging operation.
9. To make a Square rod from a given round rod, by following hand forging operation.
10. To prepare a sand mold, using the given single piece pattern.
11. To prepare a sand mold, using the given Split-piece pattern.
12. Compression strength test for moulding sand.
13. Permeability test
14. Sieve analysis to find grain fineness number of base sand.
15. To visit an industry for study and observation of Modern casting processes like investment casting, centrifugal casting, die casting, evaporative pattern casting.

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Subject Code	EC210	Subject Title	Introduction to Electronics & Communication						
LTP	3-0-2	Credit	4	Subject Category	EC	Year	2 nd	Semester	3 rd

Course Outline:

Course Objective:

To understand basics of semiconductors, rectifying action of a diode, regulated power supplies circuits, transistor, fundamentals of logic gates and basics of signals and Systems, Instrumentation.

Course Pre/Co- requisite (if any): EE103- Basic Electrical Engineering

Detailed Syllabus

UNIT 1: Fundamental of Semiconductors

Energy bands in semiconductors, intrinsic and extrinsic semiconductors, Fermi Level in Intrinsic and Extrinsic semiconductor, Carrier transport in semiconductors: diffusion current, drift current, mobility, Hall Effect and resistivity. Generation and recombination of carriers

UNIT 2: Application of Low Power and High Power Diodes

Diode Circuits: Construction, Junction diode characteristics, Half and full wave rectifiers - Expression for efficiency and ripple factor - Bridge rectifier - π Filter circuits, Clipper, Clamper and multipliers using diodes, Zener Diode Characteristics - Regulated power supply using Zener diode.

UNIT 3: Transistor Fundamentals

Transistor circuits: Characteristics of a transistor in CB, CE and CC modes - Relative merits - Biasing of Transistors- Load Line and operating point concept (both AC and DC). Construction and working of JFET and MOSFET.

UNIT 4: Digital Fundamentals and Introduction to Signals

Basic logic gates: AND, OR, and NOT – implementation of all gates using Universal gates, Number Systems conversions, Boolean algebra, K-map (upto 4 variables). Source of Information, Types of Signals.

UNIT 5: Basics of Communications & Instrumentation

Communication Systems, Communication Channels, Need of modulation, Types of modulations (Wave shapes and final expression only), Study of Piezoelectric, PMMC, LVDT and Strain Gauge transducers and their classifications and display device (7 segment) only.

Learning Outcome

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

CO1. To get acquainted student with fundamental knowledge of semiconductor devices their characteristics and modelling in different applications.

CO2. Students will be able to design and analyze electronic circuits

Text book [TB]:

1. Electronics Devices and Circuits, Millman and Halkias, Tata McGraw Hill, 4th ed.
2. Electronic Devices and Circuit Theory, Robert L. Boylestad, Prentice Hall Higher Edu. 2000.

Reference books [RB]:

1. Digital Design, Morris Mano, PHI
2. Modern Digital & Analog Communications, B. P. Lathi, OUP
3. Electronics Communication Systems, John Kennedy, Tata McGraw Hill, 4th ed.
4. Electronic Instrumentation - H. S. Kalsi

List of Experiments:

1. To identify and Study of the various components (resistor, capacitor, inductor, ICs, LED, potentiometer etc.) and electronic devices (CRO, Function Generator, Multimeter, Power Supply etc.) with their specification.
2. To study the V-I characteristics of PN Junction diode.

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3. To study the V-I characteristics of Zener diode.
4. To find the efficiency of rectifiers and ripple factor of capacitive and non-capacitive half wave rectifier.
5. To find the efficiency of rectifiers and ripple factor of capacitive and non-capacitive full wave rectifier.
6. To Study and verify clipper and clamper with biased circuits.
7. To find the characteristics of CB amplifiers.
8. To find the characteristics of CE amplifiers.
9. Determine the characteristics of FET.

To find out the power energy of various periodic and non-periodic signals.

List of two value added Experiments

1. To study the waveforms of AM
2. To study the waveforms of FM

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Subject Code	ME206	Subject Title	Theory Of Machines						
LTP	3-1-2	Credit	5	Subject Category	DC	Year	2 nd	Semester	4 th

Course Outline:

Course Objective:

To learn about mechanisms, links and machines, motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link. To understand the kinematics of gear trains. To find the power transmission through gears, belts and pulleys, frictional torque in braking systems. To know the balancing of machines and gyroscopic effect in airplanes, four wheelers and ships.

Course Pre/Co- requisite (if any): Engineering Mechanics

Detailed Syllabus

UNIT 1:

Mechanisms and Machines: Link, kinematic pairs, degrees of freedom, kinematic chain, mobility of mechanism. Inversions of four bar chain and single slider crank chain.
Velocity and acceleration analysis of mechanisms (graphical method): Velocity and acceleration analysis of four bar mechanism, slider crank mechanism by vector polygons. Concept of coriolis component of acceleration.

UNIT 2:

Cams: Types of cams, Types of followers, displacement curves for cam profiles, Follower motions including SHM, uniform velocity.
Gears: Gear terminology, law of gearing, comparison of involute and cycloidal teeth. Simple gear trains, Compound gear and Epicyclic gear trains

UNIT 3:

Static and Dynamic force Analysis: Static Force Analysis; Free Body Diagram. Force analysis of four bar Mechanism and Slider-Crank Mechanism., Turning moment Diagram Concepts and application of Flywheel
Belt drives: Flat Belt Drives, Ratio of Belt Tensions. Power transmission, Centrifugal effect, initial tension Brakes: Types and their function, Resisting torque

UNIT 4:

Vibration: Free and forced vibration of single degree of freedom systems, effect of damping;
Balancing: Balancing of rotating masses in same plane and in different planes. Balancing of reciprocating masses

UNIT 5:

Governors Porter Governor; Hartnell Governors; Controlling Force; Stability; Sensitiveness
Gyroscope: Function of gyroscope, gyroscopic couple; Effect of gyroscopic couple on ship and airplane.

Learning Outcome

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

- CO1: To understand different mechanisms and the balancing of machines to reduce undesirable stresses in machine parts
- CO2: To know design of gears and pulleys for power transmission
- CO3: To reduce the vibrations and undesirable noise in machine parts
- CO4: Understanding the effect of gyroscopic couple in aeroplanes and ships

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Text book [TB]:

1. S.S. Ratan, Theory of Machines, 4th edition, MGH, Education Publisher , 2009
2. R.S. Khurmi and J K Gupta , Theory of Machines, S Chand publication, 2005

Reference books [RB]:

1. Thomas Beven, Theory of Machines, 3rd edition, CBS Publishers and Distributors, 2005
2. Robert L Norton Kinematics and Dynamaics of Machinery, Tata McGraw Hill, 2009
3. Ghosh A and Mallick A K , Theory of Mechanism and Machines, East West Pvt. Ltd, New Delhi,1988.

List of Experiments:

1. To study the Different types of kinematic links, kinematic pairs and inversions of mechanisms.
2. To study different types of Gears and Gear trains.
3. To study different types of Cams and followers.
4. To perform the experiments of static and dynamic balancing on a shaft.
5. To perform the experiment on a governor and to plot the graph between “r” and “f”.
6. To perform the experiment on the Gyroscope & prove the law of gyroscope.
7. To perform an experiment on cam dynamics apparatus.
8. To calculate the frequency of a free vibrating spring.

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Subject Code	ME207	Subject Title	Fluid Mechanics & Fluid Machines						
LTP	3-1-2	Credit	5	Subject Category	DC	Year	2 nd	Semester	4 th

Course Outline:

Course Objective:

The students completing this course are expected to understand the properties of fluids, its kinematic and dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations. Further, the student shall be able to understand the theory of boundary layer, working and performance characteristics of various hydraulic machines like pumps and turbines.

Course Pre/Co- requisite (if any): Engineering Mathematics

Detailed Syllabus

UNIT 1: Introduction to Fluid Mechanics

Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension

Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications, Archimedes principle, buoyancy

UNIT 2: Laminar flow and boundry layer

Exact flow solutions in channels and ducts, Couette and Poiseuille flow, laminar flow through circular conduits and circular annuli-

Darcy Weisbach equation, friction factor, Moody's diagram, concept of boundary layer – measures of boundary layer thickness

UNIT 3: Dimension analysis

Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis.

UNIT 4: Hydraulic Pumps

Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles. Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump – working principle

UNIT 5: Hydraulic Turbines

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines –governing of turbines.

Learning Outcome

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

CO 1. Identify principles of fluid mechanics to be used for real life engineering problems.

CO 2. They will be able to understand the principle of floatation of objects in fluid

CO 3. Understand the working of different pumps and their components.

CO 4. Know the working of different turbines and their components

CO 5. Knowledge of dimension analysis and formation of correlations

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

Text book [TB]:

1. Bansal, R.K., “FLUID MECHANICS AND HYDRAULIC MACHINES”, LAXMI PUBLICATIONS (P) LTD, 9th edition, New Delhi, 2014.
2. Som , Intro To Fluid Mechanics 2E(Revsd) , Tata McGraw-Hill Education, 2008

Reference books [RB]:

1. Rajput, R.K., “Text Book of Fluid Mechanics”, S.Chand Publication, 4th edition, New Delhi, 2013.
2. Modi P.N and Seth S. M., “Hydraulics and Fluid Mechanics”, Standard Book House, New Delhi.2010

List of Experiments:

1. Verification of Bernoulli’s Theorem.
2. To calibrate an orifice meter and determination of the co-efficient of discharge.
3. To calibrate a venture-meter and determination of the co-efficient of discharge.
4. Determination of coefficient of discharge for rectangular notch.
5. Determination of coefficient of discharge for triangular notch.
6. Determination of coefficient of discharge for trapezoidal notch.
7. To study the transition from laminar to turbulent flow in a circular pipe.
8. Determination of friction factor in pipe flow.

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME211	Subject Title	Basic Automobile Engineering						
LTP	3-0-2	Credit	4	Subject Category	DC	Year	2 nd	Semester	4 th

Course Outline:

Course Objective:

At course end, students will be able to acquire basic knowledge about various components, assemblies and aggregates of an automobile and an over view of their working.

Course Pre/Co- requisite (if any): Design of Machine Elements

Detailed Syllabus

UNIT 1: Introduction

Classification of vehicles, Engine Powers, Firing Order, Automotive Resistance, study of main specification. Location of prime mover, chassis type, parts of an automobile.

UNIT 2: Clutches

Necessity of clutch, working of clutch, type of clutch, single plate, multiple plate, fluid flywheel, clutch assembly, construction & working details, friction disc, clutch lining materials, clutch pedal free play problems.

UNIT 3: Transmission & Differential

Introduction, function of transmission, necessity of transmission, manual transmission, sliding mesh gearbox, constant mesh gear box, synchromesh gear box, awareness of automatic transmission problems. Differential.

UNIT 4: Steering System & Suspension

Steering system requirements, front axle details & geometry, castor, camber, toe in, toe out, steering geometry, types of steering gear boxes, simple constructional details.

Need of suspension system, characteristics of leaf, coil springs. Introduction to independent suspension, shock absorber

UNIT 5: Brakes, Braking System and Wheels

Classification of brakes, drum and disk brakes, constructional & working details, introduction to hydraulic brake, parking brake, and vacuum assisted brake, leading & trailing brake shoes, working of tandem. Master cylinder wheel cylinders, characteristics of brake fluid. Wheel requirements, types of wheels, their constructional details, rims, and types of tyres, tyre selection, ordinary, radial tubeless tyres, balancing.

Learning Outcome

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

CO1: Explain the Anatomy and Identify “Chassis Components” of an automobile

CO2: Explain How a Clutch system & Drive Train Arrangement operates

CO3: Describe how the steering and the suspension systems function.

CO4: Design a brake system layout for a given vehicle and recommend tyres

CO5: Develop a strong base for understanding future developments in automobile industry

Text book [TB]:

1. Automotive Engineering by K. K. Ramalingam, SciTech Publication 2010
2. “Automobile Engineering” Jain & Asthana, Tata McGraw-Hill, New Delhi 2006

Reference books [RB]:

1. Motor vehicles by Newton Steeds and Garrot, Butterworth's, London.2006
2. Heinz Heisler, “Advanced Vehicle Technology”, Elsevier, NewDelhi, 2011.
3. Crouse & Anglin, “Automotive Mechanics”, Tata McGraw-Hill, New Delhi,2010
4. Mechanism of car by Judge A.W. Chapman and Hills Ltd, London.2006
5. Automobile engineering by Dr.Kripal Singh, Standard publisher distributors.2010

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

List of Experiments:

1. To study the construction and prepare the layouts of front engine/ rear engine drivelines
2. To study the construction and prepare the layouts of four wheel driveline
3. To study the construction of single plate and multi-plate clutches and draw sketches
4. To study the construction of diaphragm type clutch and draw sketches.
5. To study and prepare layouts of sliding mesh and constant mesh gear boxes
6. To study the construction of front and rear system and draw sketches.
7. To study the construction of steering system for manual/ power arrangement and draw sketches.
8. To study the construction of Hydraulic braking systems (Disc/ Drum) and functioning of master and wheel cylinders and draw sketches.
9. To study the construction of different types of Automobile wheels and tyres and draw sketches.
10. To study the construction and prepare layouts of different types of cooling systems
11. To study the construction of power assisted braking system and draw sketches.
12. To study and prepare the layout of lubrication system in automobile.

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME209	Subject Title	Design Of Machine Elements						
LTP	3-1-2	Credit	5	Subject Category	DC	Year	2 nd	Semester	4 th

Course Outline:

Course Objective:

This course provides an introduction to the students to have an overview of design methodologies employed for design of various machine components. Student will also learn to appreciate nature and applicability of empirical design principles, based on tests and safety considerations

Course Pre/Co- requisite (if any): Strength of Materials, Theory of Machines

Detailed Syllabus

UNIT 1:

Introduction: Definition, Methods, standards in design & selection of preferred size. Limits, fits and tolerances. Introduction Stress Concentration, Fatigue loads and Failure BIS system of designation of steels.
Design against static load: Modes of failure, Factor of safety, theories of failure, Simple & Compound stresses in machine elements. Fatigue failure, endurance limit, design for finite & infinite life, Soderberg & Goodman criteria, Modified Goodman criteria, S-N curve, Design of shafts under static and fatigue loadings.

UNIT 2:

Design of Joints: Welded joint, Riveted joints, threaded fasteners, Bolted/Screwed Joints. Pre-loaded bolts
Shaft, keys & coupling.

UNIT 3:

Mechanical springs: Design of Helical and leaf springs, Stress analysis in springs, Design against static & fatigue loading.

UNIT 4:

Design of transmission elements Basics of Spur Gear: Terminology, Classification, System of gear teeth, contact ratio, Interference, Backlash, Selection of gear materials, Design considerations. For gear pairs: spur, helical & bevel

UNIT 5:

Analysis and design of sliding and rolling contact bearings systems, Sommerfeld Nos, Boyd Raimondi Charts
Simple analysis and application of Power Screws:
CASE STUDY: Engineering Of Typ 800 /1000 cc Vehicle Clutch, Brake, Gear Box and Differential systems

Learning Outcome

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

CO1: Develop fundamental understanding of Machine Design in an engineering perspective and know how to integrate it with other subjects in engineering practice.

CO2: Know how to analyse, evaluate and recommend materials on the basis of given problem statement

CO3: Understand the influence of manufacturing processes in the design of machine element

CO4: Understand safety, reliability concepts in design of machine elements in static & dynamic Loading conditions

CO5: Develop ability to analyze, M/c Elements, Gears, springs, Bolted & Riveted Joints, Bearings.

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

Text book [TB]:

1. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill Intern; 2011.
2. V. B. Bhandari, Design of Machine Elements, McGraw-Hill, Inc., 2005.

Reference books [RB]:

1. A Text Book of Machine Design , R. S. Khurmi , J K Gupta, S Chand publication, 2005
2. Machine Design: An Integrated Approach, 2/E,By Norton,Pearson Education India, 2000

List of Experiments:

1. Design & drawing of a cotter joint.
2. Design & drawing of a knuckle joints.
3. Design & drawing of a simple screw jack.
4. Design of shaft for different loading conditions.
5. Design & drawing of rigid coupling (flanged type).
6. Design & drawing of Flexible coupling.
7. Design & drawing of key and spline.
8. Design & drawing of a leaf spring for an automobile.
9. Design & drawing of a helical spring for a given application.
10. Design and drawing of spur gear. (Involute tooth profile, interference, Pressure angle etc.)

Note -

1. Students are advised to use design data book.
2. Drawing shall be made wherever necessary on A4/A3 size drawing sheets

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME210	Subject Title	Machine Drawing And Solid Modeling						
LTP	0-0-4	Credit	2	Subject Category	DC	Year	2 nd	Semester	4 th

Course Outline:

Course Objective:

The objective of this course is to use engineering graphic skills as a means of communicating technical ideas, information and instructions. Use of Sectional views, Part sectioning, Assembly drawings and Layouts forms a part of this learning. Student uses manual drafting and design software for this communication.

Course Pre/Co- requisite (if any): Engineering Graphics

Detailed Syllabus

UNIT 1:

Introduction to Engineering Drawing, Classification of Engineering Drawings, Machine Drawing and representation of materials, Conventional representation of materials and common machine components. Representation of geometrical and dimensional tolerance and surface roughness symbols. Fundamental concepts of G and H, No-go and Go gauges.

UNIT 2:

Representation of welded joints. Projections, Sectional views and sectioning of parts and assemblies.

UNIT 3:

Engineering Graphics Software, Co-ordinate Systems, Drafting and Modelling, Evolution of geometric modeling, Advantages of solid modeling, Definition, Advantages and disadvantages of wireframe models, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG).

Computer aided Drafting: Generation of points, lines, curves, polygons, dimensioning, utility commands etc.

Solid modeling: Use of modeling software, Part model, Assembly.

UNIT 4:

Drawing of Machine Elements and simple parts: Views of any three sets of the following machine elements and parts;

- a) Popular forms of Screw threads, bolts, nuts, stud bolts.
- b) Keys, cotter joints and knuckle joint.
- c) Shaft coupling, spigot and socket pipe joint.
- d) Journal, pivot and collar and foot step bearings.
- e) Rivet joints for plates

UNIT 5:

Assembly Drawings: Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions; (any one)

- a) Engine parts – connecting rod, piston assembly.
- b) Other machine parts - Screws jacks, Machine Vices, Plummer block, Tailstock.
- c) Valves: Steam stop valve, spring loaded safety valve, feed check valve and air cock

Learning Outcome

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

CO 1. Understand Part and Assembly Drawing Concepts, Engineering Drawing and its classification

CO 2. Representation of manufacturing symbols, materials etc

CO 3. Be able to specify dimensions, and dimensional tolerances. Surface finish etc

CO4. Develop Drafting and Modeling skills using design software.

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

Text book [TB]:

1. Bhatt.N.D. and Panchal.V.M. Machine Drawing, Charotar Publishing House Pvt. Ltd. Anand (Gujrat), 388001, 49thEdition, 2014.
2. Dhawan R.K, A Textbook of Machine Drawing, 2006 S. Chand Publishing, New Delhi-110055.
3. Narayana.K.L, Kannaiah P. & Reddy K. Venkata,Machine Drawing, New Age International (P) Ltd. Publishers, NewDelhi-110002,4thEdition,2012.

Reference books [RB]:

1. Sidheswar. N, Kannaiah. P, & Sastry V.V.S.,Machine Drawing, 2010 McGraw-Hill Education (India) PrivateLimited,New Delhi-110016,2001
2. Pohit. Goutam&Ghosh. Goutam,Machine Drawing with AutoCAD, Pearson Education, Delhi.2006
3. John. K.C, A Textbook of Machine Drawing,PHI Learning, Delhi 2010.
4. Gill P.S, A Textbook of Machine Drawing, S. K. Kataria & Sons Publishers, New Delhi-110002, 18th Edition,2013

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

Humanities Electives I

Subject Code	HS241	Subject Title	Education and Social Change						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	II	Semester	IV

Course Objective

- To define the various types of education policies
- To understand the role in striving for social change.
- To overview on education and its implications on social changes to the students.

Unit 1

6 Hrs

General introduction to the place of learning in society. Learning, education and training.

Changing meanings of education across time and society. A brief historical perspective on education in India.

Unit 2

6 Hrs

Social-political arithmetic as a spurious way of understanding education and social change.

Structural functionalist perspectives and structural-conflict perspectives on education

Unit 3

7 Hrs

Class, conflict, legitimation processes, reproduction of society. Anarchist perspectives. “New” Sociology of Education. Symbolic interactionist perspectives on education. Resistances to schooling. Critical theory and education.

Unit 4

7 Hrs

Neo-Weberian perspectives on education. Status politics and education. Caste, class, gender and education in India. Indian thinkers on education. Current debates on the place of education in India.

LEARNING OUTCOME:

- The students will understand how the education system assesses the importance of education in society.
- The students will be able to take a significant action in area of education to maintain social change
- The student will be able to participate in the changes required in society.
- Education will be used as a tool to implement adequate changes in society.

TEXT BOOKS

1. Desai, A.R. (2005), *Social Background of Indian Nationalism*, Popular Prakashan.
2. Giddens, A (2009), *Sociology*, Polity, 6th ed.

REFERENCE BOOKS

- Guha, Ramachandra (2007), *India after Gandhi*, Pan Macmillan.
- Sharma R.S. (1965), *Indian Feudalism*, Macmillan.
- Deshpande, Satish (2002), *Contemporary India: A Sociological View*, Viking.
- Gadgil, Madhav & Ramachandra Guha(1993), *This Fissured Land: An Ecological History of India*, OU Press.
- Haralambos M, RM Heald, M Holborn (2000), *Sociology*, Collins.
- Mohanty, M (ed.) (2004), *Class, Caste & Gender- Volume 5*, Sage.
- Dhanagare, D.N., *Themes and Perspectives in Indian Sociology*, Rawat

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

Humanities Electives I

Subject Code	HS242	Subject Title	Introduction to Psychology						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	II	Semester	IV

Course Objective

- To understand the basic psychological processes and their applications in everyday life.

Unit 1 Introduction

5Hrs.

Psychology as a science, perspective, origin and development of Psychology, Psychology in India, Methods: experimental and case study.

Unit 2 Cognitive Processes-Perception

7Hrs.

Nature of perception, laws of perceptual organization, learning, conditioning observational learning, memory processing, information processing model, techniques for improving memory

Unit 3 Motivation and Emotion

7Hrs.

Motives: Biogenic and Sociogenic; Emotion: Nature of Emotions, key Emotion

Unit 4 Personality and Intelligence-Personality

7Hrs.

Nature and Theories; Intelligence: Nature and Theories

Course Outcome:

- The students will develop an understanding of the various psychological processes to maintain their daily activities
- The students will understand themselves better.
- The students will be better equipped for life.
- The Students will be able to demonstrate critical and creative thinking and scientific approach to understand human behaviour.

Text Books:

- Baron, R.A. and Misra, G., Psychology (Indian Subcontinent Edition). Person Education Ltd. (2014)
- Chndha, N.K. & Seth, S., The Psychological Realm: An Introduction. Pinnacle Learning, New Delhi. (2014)

REFERENCE BOOKS:

- Ciccarelli, S.K. & Meyer, G.E., Psychology (South Asian Edition). New Delhi: Tata Mc Graw Hill. (2008)
- Glassman, W.F., Approaches to Psychology (3rd Ed.) Buckingham: Open University Press. (2000)
- Passer, M.W., Smith, R.E., Holt, N. and Bremner, A., Psychology: The Science of Mind and Behaviour, McGraw-Hill Education, UK. (2008)

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Humanities Electives I

Subject Code	HS243	Subject Title	Science, Technology & Society						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	II	Semester	IV

Course Objective

To increase the basic understanding of students towards science and technology, and basic implications of science & technology on social development.

Unit 1

5Hrs.

Introduction of society, Sociological imagination, the two revolutions and their socio-economic technological and scientific implications; Social significance of science and technology, ideas beyond technology.

Unit 2

5Hrs.

Perspectives on relations between science and technology; Sociological perspective on scientific knowledge: Karl Marx, Emile Durkheim and Karl Mannheim's Sociology of knowledge; Merton's approach to science and technology.

Unit 3

7Hrs.

Ethos of science, Matthew effect in science, Thomas theorem and Mathew effect; Thomas Kunn's notions paradigm and paradigm-based science, Scientific community and growth of scientific knowledge.

Unit 4

9Hrs.

Science in India: science and technology policies in India, Scientific communities and their linkages, national and international Science, Ethics in science & engineering, environment and science and technology

COURSE OUTCOME:

- Enable students to examine the role of science and technology in social and economic development.
- The students will understand perspectives on relations between science and technology.
- The student will be able to understand the scientific temper & its social significance.
- The student will be able to understand and implement technological policies for the betterment of society.

TEXT BOOKS

1. Federic A. Lyman: Opening Engineering Students Mind to Idea to Ideas Beyond Technology. IEEE Technology and Society Magazine, Fall, pp.16-23. (2002)
2. John Theodore Rivers: Technology and the use of Nature. Technology in Society, 25(3), August, pp.403-416 (2003).

REFERENCE BOOKS

- Ronald R. Kline: Using History & Sociology to Tech Engineering Ethics. IEEE Technology and Society Magazine, Winter, pp.13-20 (2002).
- V.V. Krishna: A portrait of the scientific community in India: Historical Growth and Contemporary Problems, Gaillard et al. (eds). Scientific Communities in the Developing World, Sage (1997)

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Humanities Electives I

Subject Code	HS245	Subject Title	Ethics & Self Awareness						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	II	Semester	IV

Course Objective

- To introduce the concepts pertaining to ethical and moral reasoning and action
- To develop self – awareness

Unit 1 Introduction

4Hrs.

Definition of Ethics; Approaches to Ethics: Psychological, Philosophical, Social.

Unit 2 Psycho-social theories of moral development

4Hrs.

View of Kohlberg, Morality and Ideology, Culture and Morality, Morality in everyday context

Unit 3

8Hrs.

Ethical Concerns: Work Ethics and Work Values, Business Ethics, Human values in organizations, Self-Awareness: Self Concept: Johari Window, Self and Culture, Self-Knowledge, Self-Esteem

Unit 4

11Hrs.

Perceived Self-control, Self-serving bias, Self-presentation, Self-growth: Transactional Analysis and Life Scripts. Self-Development: Character strengths and virtues, Emotional intelligence, Social intelligence, Positive cognitive states and processes (Self-efficacy, Empathy, Gratitude, Compassion, and Forgiveness).

COURSE OUTCOME

- Students will develop an understanding of the ethical values and their application in daily activities
- Students will learn business ethics and work ethically in every sphere.
- Students will understand themselves better and develop healthy interpersonal relationships.
- Students will be able to develop themselves into wholesome personalities.

TEXT BOOKS

- Leary M.R., "The Curse of Self: Self-awareness, Egotism and the Quality of Human Life", Oxford University Press. 2004
- Louis P. P., "The Moral Life: An Introductory Reader in Ethics and Literature", Oxford University Press. 2007

REFERENCE BOOKS

- Corey, G., Schneider Corey, M., & Callanan, P., "Issues and Ethics in the Helping Professions", Brooks/Cole. 2011
- Snyder, C.R., Lopez, Shane, J., & Pedrotti, J.T., "Positive Psychology" Sage, 2nd edition. 2011

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Applicable for 2017-2021

Subject Code	ME301	Subject Title	HEAT TRANSFER						
LTP	3 1 2	Credit	5	Subject Category	DC	Year	3 rd	Semester	V

Course Outline:

Course Objective: To build a solid foundation in heat transfer exposing students to its three basic modes of conduction, convection and radiation. Introduction to governing equations with solution of practical problems using empirical correlations.

Course Pre/Co- requisite (if any): Basic Thermodynamics, Engineering Mathematics

Detailed Syllabus

UNIT 1: INTRODUCTION TO HEAT TRANSFER

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.

UNIT 2: FINS & TRANSIENT CONDUCTION

Heat transfer through fins of uniform cross-section, lumped system approximation and Biot number-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.

UNIT 3: CONVECTIVE HEAT TRANSFER

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, Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

UNIT 4: BOILING, CONDENSATION & HEAT EXCHANGERS

Boiling and condensation heat transfer, pool boiling curve, types of heat exchangers, analysis and design of heat exchangers using both LMTD and ϵ -NTU methods.

UNIT 5: RADIATION HEAT TRANSFER

Basic radiation concepts, definitions of radiative properties, radiation laws, black and gray body radiation, shape factor, black-body radiation exchange, radiation exchange between non-blackbodies in an enclosure, Infinite parallel Planes, radiation shields.

Learning Outcome

After completing the course, the students will be able to

- CO1: Formulate and analyze a heat transfer problem involving any of the three modes of heat transfer.
- CO2: Analyze heat transfer through fins and unsteady state heat conduction problems.
- CO3: Analyze convective heat transfer cases using exact, approximate, and empirical methods.
- CO4: Design heat exchange devices and understand boiling and condensation heat transfer.
- CO5: Analyze radiative heat exchange between black and gray surfaces

Text book [TB]:

1. Cengel, Y.A. and Ghajar, A.J. "Heat and Mass Transfer", Tata McGraw Hill Co.Ltd, 4th, edition, 2013.
2. Incropera, F.P., "Fundamentals of Heat & Mass Transfer", Wiley Publication, 6th edition, 2013.

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Reference books [RB]:

1. Kreith, F. and Bohn, M.S., “Principles of Heat Transfer”, Brooks/Cole, 6th edition, 2006.
2. Holman, J.P., “Heat Transfer”, TataMcGraw-Hill Publishing Company Limited, 6th edition, 2008.
3. Thirumaleswar, M., “Fundamentals of Heat and Mass Transfer”, Pearson Education, 1st edition, 2013.
4. Bejan, A., “Heat Transfer John Wiley”, 1993.
5. Massoud K., “Principles of Heat Transfer”, John Wiley, 2002

Course Structure of B.Tech. – Mechanical Engineering

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Applicable for 2017-2021

Subject Code	ME302	Subject Title	MANUFACTURING TECHNOLOGY						
LTP	3 0 2	Credit	4	Subject Category	DC	Year	3 rd	Semester	V

Course Outline:

Course Objective: Introduce student to (mechanical) measurement techniques so as to appreciate relationship between process and system in manufacturing domain for identifying techniques for quality assurance of process.

Course Pre/Co- requisite (if any): Manufacturing Process

Detailed Syllabus

UNIT 1: METROLOGY

Introduction: measurement and measuring instruments, calibration, standards of measurements, statistical analysis of errors.

Dimensions, form and surface measurements, Limits, fits and tolerances; linear and angular measurements; comparators; Answering Gauge Design; Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly.

UNIT 2: MEASUREMENTS (Lab Based Teaching)

Strain measurement: Sensors, Transducers & Strain Gauges, working, circuits, rosettes, calibration. Force and Torque Measurement: Load cells, elastic transducers.

Vibration Measurement: vibration pickups, decibel meters, vibrometers accelerometers.

UNIT 3: PRESSURE AND TEMPERATURE MEASUREMENT

Pressure Measurement: Introduction; Pressure standards and methods of pressure measurement; Manometers; Elastic pressure transducers; Calibration of pressure measuring instruments.

Temperature Measurement: Introduction; Temperature and Temperature Scales; Methods of temperature Measurement; Expansion thermometers; Filled System thermometers; Electrical temperature measuring instrument; Pyrometers; Calibration of temperature measuring instruments.

UNIT 4: OPTIMIZATION METHODS IN MANUFACTURING

Linear programming, objective function and constraints, graphical method, Simplex and duplex algorithms, transportation, assignment.

UNIT 5: PROJECT MANAGEMENT & INVENTORY CONTROL TECHNIQUES

Network models: Shortest route, minimal spanning tree, maximum flow model- Project networks: CPM and PERT, critical path scheduling; Forecasting models, Economic Order Quantity practical inventory control models.

Learning Outcome

At the end of the course the student can:

CO1:Identify measuring process, appropriate measuring tools for various manufacturing /shapes/ processes

CO2:Relate metrology parameters in manufacturing processes to dimensional accuracy, tolerances of products

CO3:Attain a hands on approach to practical measurements related to sensor based technology

CO4:Relate to overall optimization in manufacturing domain; relationship between processes and system

CO5:Identify techniques for the quality assurance of products in terms of process & resource management.

Text book [TB]:

1. R.K. Rajput, "Mechanical Measurements & Instruments 4th edition, 2014

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2. Doebelin, “Measurement Systems”, 6th edition, 2012
3. Kalpakjian and Schmid, Manufacturing processes for engineering materials -Pearson India, 2014.

Reference books [RB]:

1. Taha H. A., Operations Research, 6th Edition, Prentice Hall of India, 2003.
2. Shenoy G.V. and Shrivastava U.K., Operations Research for Management, Wiley Eastern, 1994.
3. JK Sharma Operation Research: Theory and Application, 5th ed 2013
4. Beckwith, Marangoni, Lienhard, “Mechanical Measurements”, 5th edition, 2003
5. A.K. Sawhney and P. Sawhney, “Mechanical Measurements and Instrumentation”, 12th edition, 2001

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME303	Subject Title	FLUID MACHINERY- LAB COURSE						
LTP	0 0 2	Credit	1	Subject Category	DC	Year	3 rd	Semester	V

Course Outline:

Course Objective: The students completing this course are expected to understand the working and performance characteristics of various hydraulic machines like pumps and turbines.

Course Pre/Co- requisite (if any): Fluid Mechanics and Fluid Machines

Detailed Syllabus

LIST OF EXPERIMENTS:

1. To determine the coefficient of impact jet vane combination by comparing the actual force with the theoretical force for stationary vanes of different shapes.
2. To find out Pelton wheel turbine efficiency by comparing the fluid energy to Mechanical energy.
3. To find out the performance of Francis turbine.
4. To study the performance of reciprocating pump.
5. To study the performance of centrifugal pump.
6. Study through visit of any pumping station/plant.
7. Study through visit of any hydraulic power plant.

Learning Outcome

At the end of the course the student can:

CO1: Understand the working of different pumps and their components.

CO2: Know the working of different turbines and their components.

Text book [TB]:

1. White, F.M., "Fluid Mechanics", McGraw Hill Pvt. Ltd., 7th edition, 2011.
2. Bansal R. K., "A Text Book of Fluid Mechanics and Hydraulic Machine", Lakshmi Publications, New Delhi, 2010.

Reference books [RB]:

1. Munson, "Fundamentals of Fluid Mechanics", Wiley India Pvt Ltd, New Delhi, 6th edition, 2010.
2. Duglas, J. "Fluid Mechanics", Pearson Ltd, 14th edition, New Delhi, 2013.
3. Modi P.N and Seth S. M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi.
4. Rajput, R. K., "Text Book of Fluid Mechanics", S. Chand Publication, 4th edition, New Delhi, 2013

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME368	Subject Title	Automotive Transmission Systems						
LTP	3 1 0	Credit	4	Subject Category	DE	Year	3 rd	Semester	V

Course Outline:

Course Objective This course imparts basic knowledge to students with respect to current transmission system of automobiles and impart knowledge that will enable the student to analyze and lay out a drive train system

Course Pre/Co- requisite (if any): Design of Machine Elements

Detailed Syllabus

UNIT 1: Gear Trains

Synthesis of simple, compound reverted gear trains, analysis of epicycle gear trains, problems. Necessity & function of gear boxes in Automobiles, method of calculation of gear ratios for vehicles, performance characteristics in different speeds, different types of gear boxes-sliding constant mesh, synchromesh, epi-cyclic and automatic, speed synchronizing devices, free-wheeling mechanism, overdrives, gear materials, lubrication. Planetary gearboxes, Ford T-model Wilson Gear box, determination of gear ratios, automatic overdrives.

UNIT 2: Fluid Coupling & Torque conversion

Fluid coupling advantages & limitations, constructional details, torque capacity, slip in fluid coupling, performance characteristics, measure to reduce drag in fluid coupling. Faults & remedies. Single, multi stage and poly-phase torque converters, performance characteristics.

UNIT 3: Automatic Transmission

Relative merits and demerits when compared to conventional transmission, automatic control of gears, study of typical automatic transmissions used in Indian vehicles, Ford & Chevrolet drive.

UNIT 4: Hydrostatic Drives

Advantages and disadvantages, principles of hydrostatic drive systems, construction and working of typical hydrostatic drives, Janney Hydrostatic drive.

Electrical drives: advantages and limitations, principles of Ward Leonard system of control

Modern electric drive for buses and performance characteristics.

UNIT 5: Drive line

Effects of driving thrust and torque reaction. Hotchkiss drive. Torque tube drive, radius rods. Propeller shaft. Universal joints. Final drives – different types, double reaction final drive. Two speed rear axle. Rear axle construction – full floating, three quarter floating and semi-floating arrangements. Differential – conventional type, non-slip type. Differential locks.

Learning Outcome

At the end of the course the student can:

CO1: Determine various parts and types of gear box.

CO2: Understand phenomena of Hydrodynamics and Hydrostatic Drives.

CO3: Understand the various industrial terminology from transmission system.

Text book [TB]:

1. Motor Vehicle by Newton and Steeds, Illiffee Publisher - 2000
2. Modern Transmission system by Judge AW, Chapman & Hall 2006

Reference Books [RB]:

1. Passenger Car Automotive Transmissions by Design Practices, SAE Hand book – 1994.
2. Torque converters by Heldt P.M., Chilton Book Co.-1992
3. Automotive Transmission and power trains constructions by Crouse WH, Anglin DL, McGraw- Hill

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME369	Subject Title	Vehicle Design And Data Characteristics						
LTP	3 1 0	Credit	4	Subject Category	DE	Year	3 rd	Semester	V

Course Outline:

Course Objective: This course imparts important technical specifications of an automobile from Automobile Journals and keeping this, as a guide, they must calculate and tabulate various vehicle performance parameters and design parameters and to draw curves using these data

Course Pre/Co- requisite (if any): Basic Automobile Engineering

Detailed Syllabus

UNIT 1: Introduction

Assumptions to be made in designing a vehicle, Range of values for Gross Vehicle Weight, Frontal Area, maximum speed, maximum acceleration, gradability in different gears, Basics of Automobile Design

UNIT 2: Resistance to Vehicle Motion

Calculation, Tabulation and Plotting of Curves for Air and Rolling Resistances at various vehicle speeds, Calculation and Plotting of Driving force, Power requirement for different loads and acceleration, Maximum Power calculation.

UNIT 3: Drive Train Concepts & Layouts

Determination of Gear Ratios, Acceleration and Gradability, Typical Problems on Vehicle performance Clutch, Gear Box, Differential Layout and design. Splitter, Multiplier and Auxiliary Gear Boxes. Gear shift patterns.

UNIT 4: Performance Curves

Calculation, Tabulation and Plotting of Torque and Mechanical Efficiency for different vehicle speeds, Interpolation of Pressure – Volume diagram, Calculation of frictional Mean Effective Pressure, Calculation of Engine Cubic Capacity, Bore and Stroke Length.

UNIT 5: Power Train Concepts & Layouts

Connecting rod length to Crank Radius Ratio, Plotting of Piston Velocity and Acceleration against Crank Angle, Plotting Gas force, inertia force and Resultant force against Crank Angle, Turning Moment and Side Thrust against Crank Angle

Learning Outcome

At the end of the course the student can:

CO1: Determine various parts and types of gear box.

CO2: Understand phenomena of Hydrodynamics and Hydrostatic Drives

CO3: Understand the concept of layout in power train .

Text book [TB]:

1. N. K. Giri, Automotive Mechanics, Khanna Publishers, New Delhi, 2005.
2. Heldt, P.M., High Speed Combustion Engines, Oxford and I.B.H. Publishing Co., Kolkata, 2002.

Reference Books [RB]:

1. R.B.Gupta, Automobile Engineering, s chand publication 2005
2. Julian Happian-Smith, An Introduction to Modern Vehicle Design , Elsevier, 2001.

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME347	Subject Title	Advanced Theory Of Machine						
LTP	3 1 0	Credit	4	Subject Category	DE	Year	3 rd	Semester	V

Course Outline:

Course Objective: This course will develop competency in understanding of theory of gears and gear train, applications of mechanisms and synthesis of the mechanism.

Course Pre/Co- requisite (if any): Theory of Machine

Detailed Syllabus

UNIT 1: Gears

Classification, Spur gear: definition, terminology, fundamentals, interference and under cutting, Force analysis and Friction in gears. Helical gears: nomenclature, center distance, virtual number of teeth. Spiral Gear terminology and Efficiency.

Bevel Gear & Worm and worm wheel: terminology, geometrical relationships, tooth forces, torque transmitted.

UNIT 2: Gear Trains

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.

UNIT 3: Cam and Follower

Types of cams and followers, analysis of standard motions to the follower, Determination of cam profiles for different follower motions, analysis of circular arc and tangent cams with flat face follower. Methods of control: pressure angle, radius of curvature and undercutting. Jump phenomenon of Eccentric cams.

UNIT 4: Study and Synthesis of Mechanisms

Steps in synthesis process: Type, number and dimensional synthesis. Tasks of Kinematic synthesis: Path, function and motion generation (Body guidance). Precision Positions, Chebychev spacing, Mechanical and structural errors. Graphical synthesis: Two and three position synthesis using relative pole method and inversion method for single slider crank and four bar mechanism. Freudenstein's equation for four bar Mechanism, Three position function generation using the equation. Straight line mechanisms. Indicator mechanisms

Learning Outcome

After completing this course, the student will be able to:

CO1: Understand the gear theory that will be the prerequisite for gear and gear box design.

CO2: Analyze synthesis and working principle of various mechanisms.

CO3: Understand design of mechanism and cam profile.

Text book [TB]:

1. S.S.Ratan, Theory of Machines, Third Edition, McGraw Hill Education (India) Pvt. Ltd. New Delhi.2017
2. Beven T, Theory of Machines, Third Edition, Longman Publication. 2009

Reference books:

1. A.G. Ambekar, Mechanism and Machine Theory, PHI Learning Pvt. Ltd., 19-Jul-2007
2. N.K. Meheta, Machine Tool Design, Tata McGraw Hill Publication, 1984
3. J.J.Uicker, G.R.Pennock, J.E.Shigley, Theory of Machines and Mechanisms, Third Edition, International Student Edition, OXFORD.2006

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME346	Subject Title	Turbomachines						
LTP	3 1 0	Credit	4	Subject Category	DE	Year	3 rd	Semester	V

Course Outline:

Course Objective: To enable the students, know the operation of turbomachines for compressible and incompressible fluids. To introduce students to fans, turbines, pumps etc.

Course Pre/Co- requisite (if any): Fluid Mechanics and Fluid Machines

Detailed Syllabus

UNIT 1: Energy Transfer

Definition and classification of Turbomachines, Specific work - T-s and H -s diagram -Equation of energy transfer - Losses - Various efficiencies - Effect of reheat - Preheat.

Aero-Foil section - Cascading of compressor and Turbine blades - Energy Transfer in terms of lift and drag co-efficient for compressor and turbine blades - Variation of lift -Deflection and stagnation pressure loss with incidence.

UNIT 2: Fans, Blowers and Compressors

Centrifugal fans - Blowers and Compressors - construction details - Inducers - Backward and Radial blades - Diffuser - volute casing stage work - Stage pressure rise - Stage pressure co-efficient - Stage efficiency - Degree of reaction - Various slip factors H-S diagram for centrifugal compressor.

Axial flow Fans and Compressors - Stage velocity triangles - Blade loading and flow coefficient -Static pressure rise - H-S diagram - Degree of reaction - Work done factors -Free and Forced Vortex flow performance - Stalling and Surging.

UNIT 3: Steam and Gas Turbines

Axial turbine stages - Stage velocity triangle - Work - Single stage Impulse Turbine -Speed ratio maximum utilization factor - Multistage velocity compounded impulse - Multi stage pressure compounded impulse - reaction stages - Degree of reaction - Zero reaction stages - Fifty percent reaction stages - Hundred percent reaction - Negative reaction -Free and Forced vortex flow.

Inward flow radial turbine stages - IFR Turbine - T-s diagram - and degree of reaction -Steam turbine governing – Features of Steam turbine and Gas turbine.

UNIT 4: Hydraulic Pumps

Centrifugal pumps – Work done - Head developed - Pump output and Efficiencies -priming - minimum starting speed - performance of multistage pumps - Cavitation -methods of prevention - Pump characteristics.

Axial flow pumps – Characteristics - Constructional details - Non-dimensional parameters– Efficiencies - Vibration and Noise in hydraulic pumps.

UNIT 5:Hydraulic Turbines

Classification of hydraulic turbines - Pelton wheel - Francis turbine - Kaplan and Propeller turbines - Velocity triangles - Specific speed - Theory of draft tube - Governing- Performance characteristics - Selection of turbines.

Learning Outcome

At the end of the course the student can:

CO1: Have thorough understanding of velocity triangles, thermodynamic plots and losses in turbo-machinery.

CO2: Solve analytical problems in turbo-machines for both compressible and incompressible fluid flows

CO3: Demonstrate the knowledge of working, stages, performance characteristics, governing and selection of turbo-machinery.

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

Text book [TB]:

1. S.M. Yahya, (2002), Turbine, Fans and Compressors, TMH, 2002.
2. Douglas J.F., Gasiorek, J.M and Swaffield J.A. , Fluid Mechanics, Addison – Weisly.1999

Reference books [RB]:

1. Dixon, S.L, , ‘Fluid Mechanics and Thermodynamics of Turbomachinery’, Pergamon Publishers 1999
2. Kadambi and Prasad, (1997), Energy conversion Vol. III – Turbomachines, Wiley Eastern.
3. A.H. Church and Jagadish Lal, (2000), Centrifugal Pumps and Blowers; Metropolitan Book Co, Pvt. Ltd.

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME348	Subject Title	Advanced Design Of Machine Elements						
LTP	3 1 0	Credit	4	Subject Category	DE	Year	3 rd	Semester	V

Course Outline:

Course Objective: This course introduces the students to have an overview of design methodologies employed for design of various machine components. Student will also learn to appreciate nature and applicability of empirical design principles, based on tests and safety considerations

Course Pre/Co- requisite (if any): Design of Machine Elements

Detailed Syllabus

UNIT 1:

Helical Gear: Terminology, Proportions, Beam strength and wear strength of helical gear, herringbone gear, crossed helical gear, Design of helical gears.

Bevel Gear: Terminology, Proportions, Beam strength and wear strength of Bevel Gear, Design of Bevel Gear.

Worm Gear: Types of worm, Terminology, Gear tooth proportions, Efficiency of worm gear, Heat dissipation in worm gearing, Strength and wear tooth load for worm gear, Design of worm gear.

UNIT 2:

Multi speed Gearbox: Introduction, Drawing & Design Procedure of Spur & Helical gear boxes (2-Stage).

Introduction to Commercial gearbox, Bevel gear box, Worm gear box and other Automobile Gear Boxes.

UNIT 3:

Sliding Contact Bearing Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants, Hydrodynamic journal bearing, Heat generation, Design of journal bearing, Thrust bearing-pivot and collar bearing, Hydrodynamic thrust bearing, Hydrostatic Journal Bearing.

UNIT 4:

Brakes: Types of Brakes, Design of Shoe Brake, Design of Disc Brake.

Clutches: Introduction of Clutch, Types of Clutch, Design Consideration-Uniform pressure and Uniform wear Theory, Torque and Power rating.

UNIT 5:

Belt Drives: Introduction, Types of Belt Drives, Slip, Law of Belting, Belt Joints, Analysis of Open belt and Cross belt, Condition for Maximum Power.

V-Belts- Tension Relation, Selection of V-Belts.

Chain Drives: Types of Chain drives, chain drive geometry, Design of Chains, Polygon effect, Power rating.

Learning Outcome

After completing this course, the students can:

CO1: Develop fundamental understanding of Machine Design in an engineering perspective and know how to integrate it with other subjects in engineering practice.

CO2: Know how to analyze, evaluate and recommend materials on the basis of given problem statement.

CO3: Understand the influence of manufacturing processes in the design of machine elements

CO4: Understand safety, reliability concepts in design of machine elements in static & dynamic Loading conditions

CO5: Develop ability to analyze, M/c Elements, Gears, Springs, Bolted & Riveted Joints, Bearings.

Text book [TB]:

1. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill Intern; 2011.
2. V. B. Bhandari, Design of Machine Elements, McGraw-Hill, Inc., 2005.

Reference books [RB]:

1. Kamaraju Ramakrishna, Design of Machine Element, Oxford University Press, 2017
2. Spotts, Design of Machine Elements, Pearson Education India, 2004.

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME350	Subject Title	Operations Research						
LTP	3 1 0	Credit	4	Subject Category	DE	Year	3 rd	Semester	V

Course Outline:

Course Objective: To provide students the knowledge of optimization techniques and approaches about networking, inventory, queuing, decision and replacement models.

Course Pre/Co- requisite (if any): Manufacturing Technology

Detailed Syllabus

UNIT 1: Linear Models

Introduction to Operations Research – Linear Programming - Mathematical Formulation –Graphical method – Simplex method – Duality – Two – Phase Simplex method –Transportation problems – Northwest Corner method – Vogel’s Approximation method –MODI method – Assignment problems – Applications.

UNIT 2: Sequencing and Networks

Sequencing –Problem with N jobs and 2 machines - 3 machines and ‘M’ machines. Network models – Basic Concepts – Construction of Networks – Project Network – CPM and PERT - Critical Path Scheduling – Crashing of Network.

UNIT 3: Inventory Models

Inventory models – Various Costs and Concepts–EOQ–Deterministic inventory models –Production models – Stochastic Inventory models – Buffer stock

UNIT 4: Queuing Models

Queuing models – Poisson arrivals and Exponential service times – Single channel models and Multi-channel models.

UNIT 5: Decision Models

Decision models – Game theory – Two-person zero sum game – Graphic solution - Property of dominance – Algebraic solution

Learning Outcome

At the end of the course the student can:

CO1:Apply operations research techniques like L.P.P, scheduling and sequencing in industrial optimization problems.

CO2:Solve transportation problems using various OR methods and illustrate the use of OR tools in a wide range of applications in industries.

CO3:Analyze various OR models like Inventory, Queing, Replacement, Simulation, Decision etc and apply them for optimization.

Text book [TB]:

1. Hira D S and Gupta P K, (2007), Operations Research, S.Chand & Sons.
2. Hamdy Taha, (2009), Operations Research: An Introduction, Pearson Education Inc.

References [RB]:

1. Panneerselvan. R. (2006), Operation Research, Prentice Hall of India Pvt Ltd
2. Kanti Swarup, Gupta P.K., and Manmohan, (2004), Operations Research, S.Chand & sons.
3. P.Chattopadhyay Boiler Operation Engineering: Questions and Answers 3rd Edition Tata McGraw Hill.

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME349	Subject Title	Automotive Electrical & Electronics						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	3 rd	Semester	V

Course Outline:

Course Objective: This course provides an understanding of application of electrical and electronic system in automobile vehicle.

Course Pre/Co- requisite (if any): Basic Automobile Engineering

Detailed Syllabus

UNIT 1: Batteries and Accessories

Principle and construction of lead acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on batteries, maintenance and charging. Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods – Horn, wiper system and trafficar.

UNIT 2: Starting and Charging System

Starting System: Condition at starting, behavior of starter during starting, series motor and its characteristics, principle and construction of starter motor, working of different starter drive units, Starter motor requirements, care and maintenances of starter motor, Drive mechanisms, starter switches.

Charging System: Generation of direct current, shunt generator characteristics, armature reaction, third brush regulation, cut out. Voltage and current regulators, compensated voltage regulator, alternators principle and constructional aspects and bridge rectifiers, new developments

UNIT 3: Fundamentals of Automotive Electronics

Current trends in automotive electronic engine management system, electromagnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, on board diagnostic system, security and warning system.

UNIT 4: Sensors and Actuators

Types of sensors: sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors, relay.

UNIT 5: Safety and Security Systems

Keyless entry system, Antilock braking system, Air bag restraint system, Adaptive cruise control system, Voice warning system, Seat belt system, antitheft system.

Learning Outcome

At the end of the course the student can:

CO1: Understand the basic auto electrical systems.

CO2: Understand the layout of wiring and connections of electrical systems in automobiles.

CO3: Understand the working of different electrical components used in automobiles.

Text book [TB]:

1. Bechhold "Understanding Automotive Electronics", SAE, 1998.
2. Kholi.P.L. "Automotive Electrical Equipment", Tata McGraw-Hill Co., Ltd., New Delhi, 1975.

Reference books [RB]:

1. Crouse, W.H. "Automobile Electrical Equipment", McGraw-Hill Book Co., Inc., New York, 3rd edition, 1986.
2. Robert Bosch "Automotive Hand Book", SAE (5th Edition), 2000.
3. William B. Ribbens, Understanding Automotive Electronics, William B. Ribbens, -Sixth edition Elsevier Science 2003

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME341	Subject Title	Energy Conservation And Management						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	3 rd	Semester	V

Course Outline:

Course Objective: This course will give an understanding of the energy data from industries and carry out energy audit for energy savings

Course Pre/Co- requisite (if any): Basic Thermodynamics, Applied Thermodynamics I

Detailed Syllabus

UNIT 1:

Introduction to energy & power scenario of world, National Energy consumption data, and environmental aspects associated with energy utilization; Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing.

UNIT 2:

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.

UNIT 3:

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.

UNIT 4:

Energy conservation in major utilities; pumps, fans, blowers, compressed air systems, Refrigeration & Air Conditioning systems, Cooling Towers, DG sets.

UNIT 5:

Energy Economics- discount period, payback period, internal rate of return, net present value; Life Cycle costing- ESCO concept.

Learning Outcome

After completing this course,

CO1: the student will be able to perform of energy auditing for the energy consumption of industries.

CO2: Students will understand the requirement and conservation of energy in day today life,

CO3: Students will understand about the management skills for conservation of energy and its resources.

Text book [TB]:

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.

Reference books [RB]:

1. Murphy W.R. and McKay G., Energy Management, Butterworths, London, 1987.
2. Energy Manager Training Manual, Bureau of Energy Efficiency (BEE) under Ministry of Power, GOI, 2004 (available at www.energymanagertraining.com).

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME342	Subject Title	Composite Materials						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	3 rd	Semester	V

Course Outline:

Course Objective: To enable the students, know and understand the mechanical behavior of composite materials

Course Pre/Co- requisite (if any): Strength of Materials, Materials Engineering

Detailed Syllabus

UNIT 1:

Definition and applications of composite materials, classifications, Fibers- glass, carbon, ceramic and aramid fibers. Matrices- polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Fillers and whiskers. Advantages and limitations of composites

UNIT 2:

Mechanical behaviour of composite materials, surface treatment of fibers, thermosets matrix materials, Thermoplastics and other matrix materials, Manufacturing of thermoset composites, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes

UNIT 3:

Composite mechanics Terminology, Behaviour of unidirectional composites, Behaviour of short fiber composites Analysis of orthotropic ply. Hook's Law for orthotropic lamina, Relation between Engg. constants and Elements of matrices for orthotropic ply, Transformation of Engg. constants, Failure in isotropic materials

UNIT 4:

Analysis of laminated composites, symmetric laminates, angle ply laminates, cross ply laminates, laminate, evaluation of lamina properties, determination of stress and strain in laminate, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials,

UNIT 5:

Residual stresses during curing, prediction of laminate failure, thermal analysis of composite laminates. Analysis of laminated plates - equilibrium equations of motion, static bending analysis, buckling analysis, free vibrations, natural frequencies.

Learning Outcome

At the end of the course the student can:

CO1: Have an overview of the mechanical behaviour and application of composite materials.

CO2: Get an overview of the methods of manufacturing composite materials

CO3: students will understand various mechanics of composite materials.

Text book [TB]:

1. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.
2. Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill, 1998.

Reference books [RB]:

1. F. L. Matthews, Rees D. Rawlings , Composite Materials: Engineering and Science Woodhead Publishing, 1999 - Composite materials.
2. Autar K. Kaw, Mechanics of Composite Materials, CRC Press, 30-May-1997

Course Structure of B.Tech. – Mechanical Engineering

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Applicable for 2017-2021

Subject Code	ME345	Subject Title	Industrial Engineering & Management						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	3 rd	Semester	V

Course Outline:

Course Objective: This course introduces the students to have an overview of industrial engineering and management. Student will learn about production and its relation with productivity, selection of plant location and layout. Student will also learn about inspection, quality control and basics of managements.

Course Pre/Co- requisite (if any): Manufacturing Technology

Detailed Syllabus

UNIT 1: Production, Productivity and work study

Definition of production, Types of production systems, Definition of productivity, Application and advantages of productivity, Improvement tools, Reasons for increase and decreases in productivity.

Introduction of work study, Importance and advantages of work study, Work study procedure.

UNIT 2: Location Selection and Plant Layout

Nature of location decision, Importance of plant location, Dynamic nature of plant location, Choice of site for selection, State regulations on location, Government policies on decentralization, Industrial estates, Economic survey of site selection.

Principles of plant layout and its types, Factors affecting layout, Flow pattern and factors governing flow pattern, Travel chart, Analytical tools of plant layout.

UNIT 3: Production Planning and Control

Definition of production planning and control (P.P.C), Functions and objectives of P.P.C, Product design and development including standardization and simplification, Sales forecasting and its different techniques, Sequencing, Loading and scheduling, Techniques and their selection, Line of balance, Assembly line balancing, Dispatching, and Progress control.

UNIT 4: Inspection and Statistical Quality Control

Inspection– functions, Types, Objectives and benefits, Quality control– principles, Concepts of quality circles, Total quality management, Quality assurance, Quality audit, ISO, and Six sigma. SQC concept, Variable and attributes, Normal distribution curves and its property charts for variable and attributes and their applications and interpretation (analysis) process capability, Acceptance sampling, Sampling plans, OC curves and AOQ curves.

UNIT 5: Basics of Management

Definition of management, Functions of management– Planning, Organizing, Staffing, Directing, Co-ordination, Controlling, Motivating, Communication, Decision making. Principles of management, Administration and management, Nature of management, Levels of management, Managerial skills, Managerial roles, Styles of management. Forms of organization– Line, Staff, Line-staff, Forms of ownership – Partnership, Joint stock, Cooperative society, Govt. sector etc.

Learning Outcome

After completing this course, the students can:

CO1: Develop fundamental concepts of industrial engineering and management.

CO2: To familiarize the students with production, productivity and principles of work-study.

CO3: To enable the students understand the selection of plant location and layout.

CO4: To provide students an insight into the concepts of production planning and control.

CO5: To enable the students understand the inspection and statistical quality control.

Text book [TB]:

1. Riggs, “Production System, Planning, Analysis and Control”, Wiley, 3rd ed. 1991.

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

2. Mahajan, "Industrial Engineering and Production Management", Dhanpat Rai & Co., 2005.
3. Martand Telsang, "Industrial Engineering and Production Management", S Chand & company, 2nd ed. 2006.

Reference Books[RB]:

1. Banga and Sharma, "Industrial Engineering and Production Management", Khanna publishers.
2. Shankar, "Industrial Engineering and Management", Galgotia Publications Pvt. Ltd, 1st ed. 2000 (Reprint 2006).
3. Khanna, "Industrial Engineering and Management", Dhanpat Rai Publications, 17th edition 2010.

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

Humanities Electives II

Subject Code	HS384	Subject Title	Principles of Management						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	III	Semester	V

Course Objective

- The objective of this course is to familiarize B.Tech. Students with the roles, responsibilities, and skills required of modern managers.
- This course will be present the concepts of management as it applies to current thinking in the workplace.

Unit 1 Overview of management

5 Hrs.

Definition-Management-Role of managers-Organization and the internal and environmental factors –Trends and Challenges of Management in India.

Directing – delegation –span of control– communication, Controlling

Unit 2 Management Information

4 Hrs.

Introduction to functional areas of management, Operations management, Human resources management, Marketing management, Financial management

Unit 3 Planning Approach to Organizational Analysis

10 Hrs.

Design of organization structure; job design and enrichment; job evaluation and merit rating

Unit 4 Motivation and Productivity

7 Hrs.

Theories of motivation, Leadership styles and Managerial grid. Co-ordination, monitoring and control in organizations. Techniques of control; Few Cases on current management issues in India

COURSE OUTCOME:

- To present the topics in management, management theories, while at the same time focusing on practical applications in the real world especially for engineers.
- Evaluate the global context for taking managerial actions of planning, organizing and controlling.
- Assess global situation, including opportunities and threats that will impact management of an organization.
- Integrate management principles into management practices.

TEXT BOOKS:

1. Schermerhorn, Management and Organisational Behaviour essentials, Wiley India
2. Koontz: Essentials of Management, PHI Learning.
3. Hirschey: Managerial Economics, Cengage Learning.
4. A V Rau: Management Science, BSP, Hyderabad
5. Mote, I Paul and Gupta: Managerial Economics Concepts & Cases, TMH, New Delhi.
6. Stephan R Robbins Fundamental of Management, Pearson

REFERENCE BOOKS

- Koontz, H., and Weihrich, H., Essentials of Management: An International Perspective, 8th ed., McGraw Hill, 2009.
- Hicks, Management: Concepts and Applications, Cengage Learning, 2007.
- Mahadevan, B., Operations Management, Theory and Practice, Pearson Education Asia, 2009
- Kotler, P., Keller, K.L, Koshy, A., and Jha, M., Marketing Management, 13th ed., 2009.
- Khan, M.Y., and Jain, P.K., Financial Management, Tata-Mcgraw Hill, 2008.

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

Humanities Electives II

Subject Code	HS391	Subject Title	Positive Psychology & Living						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	III	Semester	V

Course Objective

- To increase awareness for relevance of positive emotions at workplace.
- To equip students with psychological skills to maximize happiness and virtues like compassion, love and wisdom through experiential, workshop based and interactive activities along with assigned lectures and reading

Unit 1 What is positive psychology?

7Hrs.

Introducing Positive Psychology: Definition, goals, assumptions, key concepts and relationships with health psychology, developmental psychology, social psychology and psychology of religion, Meaning and measure of Happiness: Hedonic and Eudemonic perspective, Yogic notion of bliss

Unit 2 Positive Emotions, Cognitive states and Well-being

9Hrs.

What are positive emotions? The broaden and build theory, relevance of positive emotional states for physical, social & psychological resources, Positive emotions and well-being: Happiness and positive behavior, positive emotions and success, resilience, Self-efficacy, Optimism, Hope, Wisdom, Mindfulness and flourishing

Unit 3 How to enhance well-being?

5Hrs.

Use of postures, breathing practices, Sounds, dietary consumption

Unit 4 Positive Psychology at work place

5Hrs.

Maximizing achievement, conflict resolution, gratitude, positive leadership

COURSE OUTCOME:

- Students learn about modern psychological knowledge of happiness.
- Students acquire skills to cultivate positive emotions.
- Measure and build individual, workplace and educational flourishing; plan, implement and assess positive psychology.
- Students will gain an understanding of what contributes to well-being and how to build the enabling conditions of a life worth living.

TEXT BOOK:

Snyder (2011). Positive Psychology: The Scientific and Practical Explorations of Human Strengths. New Delhi: Sage.

REFERENCE BOOKS:

- Carr, A. (2004). Positive Psychology: The science of happiness and human strength. UK: Routledge.
- Peterson, C. (2006). A Primer in Positive Psychology. New York: Oxford University Press.
- Seligman, M.E.P. (2002). Authentic Happiness: Using the New Positive Psychology to Realize Your Potential for Lasting Fulfillment. New York: Free Press/Simon and Schuster.
- Snyder, C.R., & Lopez, S.J. (2007). Positive psychology: The scientific and practical explorations of human strengths. Thousand Oaks, CA: Sage.
- Snyder, C. R., & Lopez, S. (Eds.). (2002). Handbook of positive psychology. New York: Oxford University Press.

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Humanities Electives II

Subject Code	HS385	Subject Title	Engineering Economics						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	III	Semester	V

Course Objective:

- To provide the basic overview of economics in engineering perspectives.
- To increase the understanding of students to solve the engineering problems through economic theories.
- To increase the understanding of students to use economics theories in project investment of industries

Unit 1 General Overview of Economics

6Hrs.

Nature and Scope of Economics in engineering perspective; **Theory of Demand Analysis:** Meaning and Types, Law of demand, Exceptions to the Law of Demand, Elasticity of Demand; **Theory of Supply Analysis:** Law of Supply and Elasticity of Supply; Mathematical Explanation on cost, revenue and profit function

Unit 2 Production Function and Its Applications

6Hrs.

Production Function: Short-run and long-run Production Function; **Mathematical Explanation:** Laws of Returns to Scale & Law of Diminishing Returns Scale; **Concept of Cost and Its Types:** Total cost, fixed cost, variable cost, average variable cost, average fixed cost, marginal cost, explicit and implicit cost; **Break-Even-Analysis:** Importance and graphical presentation, mathematical problems

Unit 3 Time Value of Money and Project Evaluation

8Hrs.

Time Value of Money: Simple and Compound, Uniform Series Compound Interest Formula, Present Worth Analysis, Future Worth Analysis, Future Value through Annuity, Rate of Return Analysis, Cash flow diagrams; **Depreciation:** Introduction, Straight Line and Declining Balance Method of Depreciation; **Project Evaluation Techniques:** Present Worth Method, Future Worth Method, Annual Worth Method; Benefit Cost Analysis: Conventional and Modified B/C Ratio with PW method

Unit 4 Banking and Finance

6 Hrs.

Banking Sector: Functions of the Commercial Bank and Central Bank, Financial Institutions; **Financial Market:** Money Market and Capital Market; **Monetary and Fiscal Policy:** Objectives, Instruments, Tools in Indian Economy; **Inflation:** Causes, Effects and Methods to Control it, Measurement of Inflation- Consumer Price Index and Whole Price Index; Deflation and Stagflation; **Business Cycles:** Various phases, Control and Measurement, Impact on business cycles on economic activities

COURSE OUTCOME

- Students will be able to apply economic principles and calculations to solve engineering projects.
- To students will be efficient to get the idea of production activities and its applications in industries.
- Students will be competent to estimate the present and future value of money on their various investment plans.
- Develop the ability to account for time value of money using engineering economy factors and formulas, as well as the implications and importance of considering taxes, depreciation, and inflation.

TEXT BOOKS TEXT BOOKS

1. Pravin Kumar (2015). Fundamental of Engineering Economics. Raj Kamal Press, New Delhi.
2. Riggs J.L., Dedworth, Bedworth D.B., and Randhawa, S.U. (1996). Engineering Economics. McGraw Hill International, New Delhi
3. PanneerSelvam R. (2001). Engineering Economics. Prentice Hall of India Ltd, New Delhi.

REFERENCE BOOK

- L.M. Bhole (2007). Financial Institutions and Markets. Tata McGraw Hill, New Delhi.

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Humanities Electives II

Subject Code	HS382	Subject Title	Literature, Language & Society						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	III	Semester	V

Course Objective

- The focus of the programme is on the interaction between literature & Society, and Literature and visual culture
- To discuss how Literature reacts to major changes in society

Unit 1

4Hrs.

Nature and Functions of Literature, Literature and Society with special reference to Indian Literature and Indian Society, Literary Forms, Poetry, Drama, Fiction, Essay, Autobiography

Unit 2

7Hrs.

Approaches to the Study of Literature, Reader response to the study of Literature, Interpretation, Appreciation, Evaluation, Special problems in understanding Modern Literature.

Unit 3

9Hrs.

Social dimension of language. problems of multilingual communities, dominance and conflict, shift and attrition, language and the state, language and nation, Indian multilingualism, language variation, language and identity, linguistic prejudice and inequality, standardization, linguistic determinism, critical discourse analysis, and methodological issues.

Unit 4 TEXT

6 Hrs.

Jerome K Jerome: Three Men on a Bummel (selection), Martin Amis: Last Days of Muhammad Atta, Li Ho: A Girl Comb her hair, R.K. Narayan: Malgudi Days (selection)

COURSE OUTCOME

- Students will read critically from a variety of genres, specifically poetry, drama, non fiction, and fiction.
- Students will read literature more carefully and meaningfully, practicing close-reading skills.
- Students will understand the relation between historical and cultural contexts.
- The students will develop a critical understanding of how literature can both uphold and resist existing structures of power.

TEXT BOOKS

- Jerome K Jerome: Three Men on a Bummel (selection), Arrow smith Publications
- R.K. Narayan: Malgudi Days (selection), *Indian Thought Publications*

REFERENCE BOOKS

- Martin Montgomery, An Introduction to Language and Society (Studies in Culture and Communication) Routledge; 2 edition (December 22, 1995)
- Robe Pope, *An Introduction to Language Literature and Culture*. Routledge, 2005

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Subject Code	HS301	Subject Title	APTITUDE & SOFT SKILLS III						
LTP	3 0 0	Credit	0	Subject Category	AC	Year	III	Semester	V

Course Outline: The first step of an intensive two step placement training module equips the students to successfully handle the placement program of any on-campus/off-campus company. It not only provides career guidance about the selection process but also helps students in profile building; self-introduction and proactive internship search techniques.

Course Objective:

1. Interpret the questions of aptitude building objectively and prepare for various competitive examinations
2. Understand the optimized approach of dealing with placement questions
3. Learn ways of representing themselves effectively in formal settings

Course Pre / Co-requisite (if any): Understanding of writing concepts, general intelligence of LR, algebra concepts and equation formation, time management and presentation skills covered in Aptitude and Soft Skills I and II.

Detailed Syllabus

UNIT 1 - QUANTITATIVE APTITUDE	11 HOURS
<p>Number System 03 hours</p> <p>Types of numbers; Factors; Divisibility test; Place and face Value; Base system; Remainder theorem; digits at the unit places and finding last two digits in a given expression; Calculating number of zeroes, Finding maximum power of any prime number or any composite number in any factorial, HCF and LCM.</p> <p>Fractions–Types of fractions; Conversion of terminating and non-terminating types of decimal into fraction; Subtraction, addition and multiplication of terminating and non-terminating decimals.</p> <p>Percentage 02 hours</p> <p>Basic concepts; Conversion from fraction to percentage; Application of percentage in – Expenditure, Cost, Consumption problems; Population increase or decrease problems; Production, Manpower and Working hour problems; successive increment or decrement; Comparison of salary or numbers; Percentage change in area or volume, etc.</p> <p>Ratio and Proportion 02 hours</p> <p>Ratio, Proportion and Variation: Ratio- Introduction; Types of ratios; Comparison of Ratios; Concept of duplicate, triplicate, sub-duplicate and sub-triplicate ratios.</p> <p>Proportion and variation – Concept of direct, inverse, continuous and mean proportions.</p> <p>Profit and Loss 02 hours</p> <p>Introduction; Concept of single, double and triple discount and marked price.</p> <p>Simple / Compound Interest 02 hours</p> <p>Simple Interest and compound Interest: Basic concept of Principal, Time, Amount and Rate of Interest; Concept of Lent money.</p>	
UNIT 2- VERBAL APTITUDE	09 HOURS

Tenses **02 hours**

Understanding and aligning them with the various question types.

Subject – Verb Agreement **02 hours**

Subject-Verb Agreement: Rules and Applications; commonly confused words-II; Gerunds, Active and Passive voice.

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Question Types

03 hours Introduction to Question

types-I: Fill in the blanks, One word Substitution, Spellings, understanding the right word choice, concept of para jumbles and para completion, reading comprehension, verbal analogies, odd man out, phrases and idioms.

Introduction to Question types-II: Error identification, Homophones, Usage of the various figures of speech, commonly confused words and phrases, techniques for tackling synonyms and antonyms.

Reading Comprehensions

02 hours Reading

Comprehension: Basics of Comprehensions, different tones of comprehensions, cracking question types like contextual vocabulary, fill in the blanks, true/false questions, reference to context, summary and title of the passage, paraphrasing the text.

UNIT 3- LOGICAL REASONING

10 HOURS

Coding Decoding and Sequences

02 hours

Coding Decoding, Cryptarithmic, Sequence and Series - Finding the missing term/wrong term in the logical sequence of letter/number/word/alphanumeric, Continuous pattern series.

Verbal Analogies and Odd man out

02 hours

Verbal Analogy based on various parameters - Antonym / synonym relationship, Quantity and unit, Individual and Group, Product and Raw material, cause and Effect etc.

Odd man out based on several kind of relationship – Relationship based on meaning, functional relationship, even- odd or prime-composite, divisibility rule, etc.

Blood Relation and Direction Sense

02 hours Blood Relation-

Indicating form / puzzle form / coding form, Direction Sense, Direction puzzles.

Seating Arrangements

02 hours Seating Arrangements

– Linear / Circular / Distribution / comparison/ Floor and box arrangement /Quant based arrangements/ etc.

Critical Reasoning– I

02 hours

Statement and assumptions, course of action, statement and conclusion, probably true/false.

UNIT 4- NON VERBAL COMMUNICATION

04 HOURS

Types of Non Verbal Communication, Body Language-Exercises and Activities, Error Analysis & Feedback Sharing.

Suggested Activities & Exercises: (i) Communication Origami, (ii) Power of body language, (iii) Draw it.

UNIT 5- ONLINE PROFILING & SOCIAL MEDIA ETHICS

05 HOURS

Social Media ethics and etiquette, Do's & Don'ts, LinkedIn Profile Development, Example Sharing, Feedback Sharing & Error Analysis.

Suggested Activities & Exercises: (i) Online Portfolio Creation, (ii) Fun Social Media Projects, (iii) LinkedIn profile development project with feedback sharing and error analysis

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LEARNING OUTCOME:

By the end of this semester, students will be able to perceive and analyse the requirements of placement trends as detailed information about the selection process would be provided by career guidance. They will be more confident and will be able to develop a professional profile, both online and offline.

Text book [TB]:

1. Quantitative Ability:How to prepare for Quantitative Aptitude, Arun Sharma, McGraw Hill, 8th edition-2018.
2. Logical Reasoning: A Modern Approach to Logical Reasoning-R.S. Aggarwal S Chand Publishing; 2ndColour edition-2018.
3. Verbal Aptitude: English is Easy- Chetanand Singh, BSC Publication-2018.
4. Soft Skills: The Definitive Book of Body Language by Barbara and Allan Pease; RHUS; 1 edition-2006.

Reference books [RB]:

1. QA :Quantitative Aptitude for Competitive Examinations- R.S. Agarwal S. Chand Publications-2017.
QA: Quantitative Aptitude- Saurabh Rawat and Anushree Sah Rawat, Savera Publishing House, 1st Edition-2016.
2. LR: Logical Reasoning and Data Interpretation for the CAT - Nishit K Sinha, Pearson India; 5th edition-2016.
LR: Wiley's Verbal Ability and Reasoning - P A ANAND,Wiley-2016.
3. VA : Oxford Guide to English Grammar- John Eastwood, Oxford University Press-2003.
VA: Fun with grammar- Suzanne W. Woodward Pearson Education ESL-1996
4. Soft Skills :How to Talk to Anyone by Leil Lowndes Harper Element; New edition-2015.
Soft Skills: Crucial Conversations: Tools for Talking When Stakes Are High by Kerry Patterson, Joseph Grenny, Ron McMillan, and Al Switzler; Brilliance Audio; Abridged, Updated edition-2013.

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Applicable for 2017-2021

Subject Code	ME304	Subject Title	Advanced Automobile Engineering						
LTP	3 0 2	Credit	4	Subject Category	DC	Year	3 rd	Semester	VI

Course Outline:

Course Objective: -

Aim of this course is to make students know and understand, constructional design basics, operating control characteristics of vehicle subsystems, vehicle homologation & safety design aspects.

Course Pre/Co- requisite (if any): Applied Thermodynamics II

Detailed Syllabus

UNIT 1: Vehicle Engineering

Categorization and Homologation of vehicles. Classification & Constructional details of various vehicles. Introduction to wheel loaders, ATV, sports vehicles their nomenclature.

Passenger car Regulations. Basic ergonomics, driver's visibility and safety measures in vehicle design. Car body construction; design criteria. AIS testing standards, Crash tests and crumple zones.

UNIT 2: Power Plant

Constructional features & working characteristics of two & four stroke petrol & diesel engines. Introduction to Engine controls.

Vehicle performance curves: Tractive effort, resistance and gradability for an automobile.

UNIT 3: Sub Systems I

Suspension system: Types of suspensions, introduction to basics of suspension analysis, types of dampers and springs used in suspensions and their design features.

Electric vehicles:

Introduction, types of batteries, types of electric vehicles. Hybrid vehicles

UNIT 4: Sub Systems II

Chassis & Controls

Vehicle frame design and its types. Vehicle Transmission Systems: Basic design principles and operational control, Antilock brake system and throttle controls, Controls on dashboard meters.

Automobile Air Conditioning:

Requirements, Cooling & heating system

UNIT 5: Case Study Indian Two, Three & Four Wheelers / Testing

Case study on features of Indian models of PC, LCV.

Learning Outcome

At the end of the course the student can:

CO1: Acquire vehicle sub systems design and control basics with current vehicles technology scenario

CO2: Students will get the knowledge about power plant of vehicles and its sub system in details.

CO3: students will understands about chassis and it control system in details.

Text book [TB]:

1. Motor Vehicles by Newton Steeds and Garrot, Butterworths, London – 2000
2. Automotive mechanics by Srinivasan, TMH, New Delhi 2006
3. Automotive Technology by Sethi, TMH, New Delhi 2010

Reference books [RB]:

1. Motor Vehicles by Newton Steeds and Garrot, Butterworths, London – 2000.
2. Mechanism of the Car by Judge A.W, Chapman and Halls Ltd., London –1986
3. Automotive Chassis and Body by Crouse W.H, McGraw –Hill, New York –1971.
4. Automobile Engg. by K.K. Jain, R.B. Asthana, TMH –2002.
5. Motor Cycle Engineering by Irving P.E., Temple Press Book, London – 1992.

List of Experiments:

1. Basic Road performance test of a Three Wheeler

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2. Basic Brake and Steering parameter measurement of a 4 Wheeler
3. Performance test of a shock absorber.
4. Two wheeler chain tension test.
5. Three & four wheeler brake and clutch play adjustment as per specification.
6. Assembly and Dismantling of SI cylinder head and study combustion chamber configuration
7. Assembly and Dismantling of CI cylinder head and study combustion chamber configuration
8. Dismantling and assembling of two / three wheeler gear box and finding gear ratios.
9. Dismantling and assembling of two / three wheeler handle bar steering system study of linkage & suspension mechanism
10. Study and layout of different three wheeler chassis frames and power transmission system.
11. Study and layout of typical Indian Tractor power train system.

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Subject Code	ME351	Subject Title	Design Of Heat Exchangers						
LTP	3 1 0	Credit	4	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

Course Objective: To impart knowledge of various types of heat exchangers, their construction, design and performance behavior.

Course Pre/Co- requisite (if any): Heat Transfer

Detailed Syllabus

UNIT 1: Basic Design Methods of Heat Exchangers

Introduction, Arrangement of Flow Path in Heat Exchangers, Basic Equations in Design, Overall Heat Transfer Coefficient, LMTD Method for Heat Exchanger Analysis, Parallel and Counter Flow Heat Exchanges, Multipass and Cross Flow Heat Exchangers, The ϵ -NTU Method for Heat Exchanger Analysis, Heat Exchangers Design Calculations and Methodology.

UNIT 2: Forced Convection Correlations for the Single Phase Heat Exchangers

Hydrodynamically Developed and Thermally Developing Laminar Flow in Smooth Ducts, Annular, Turbulent Forced Convection, Turbulent Flow in Smooth Ducts, Heat Transfer from Smooth-Tube Bundles, Heat Transfer in Helical Coils and Spirals, Nusselt Numbers of Helical and Spiral Coils, Heat Transfer in 90° and 180° Bends.

UNIT 3: Pressure Drop and Fouling Factor in Heat Exchanger

Tube-Side Pressure Drop in Circular and non-circular Cross Sectional Tubes, Pressure Drop in Tube Bundles in Cross flow, Pressure Drop in Helical and Spiral Coils, Heat Transfer and Pumping Power Relationship.

Effect of Fouling on Heat Transfer, Effect of Fouling on Pressure Drop, Categories of fouling, Design of Heat Exchangers Subject to Fouling, Fouling Resistance, Cleanliness Factor.

UNIT 4: Double Pipe Heat Exchangers and Shell-and-Tube Heat Exchangers

Double-Pipe Heat Exchangers: Thermal and Hydraulic Design of Annulus and Tubes, Finned inner tubes.

Shell-and-Tube Heat Exchangers: Baffle Type and Geometry, Shell-Side Heat Transfer and Pressure Drop, Shell-Side Heat Transfer Coefficient, Shell-Side Pressure Drop, Tube-Side Pressure Drop

UNIT 5: Design of Phase Change and Compact Heat Exchangers.

Shell and Tube Condenser, Evaporators for Refrigeration and Air-Conditioning, Steam Turbine Exhaust Condenser, Air-Cooled Condensers.

Compact Heat Exchanger; Heat Transfer and Pressure Drop, Heat Transfer Enhancement, Plate-Fin and Tube-Fin Heat Exchangers. Performance evaluation.

Learning Outcome

At the end of the course the student can:

CO1: Understand the basic design methods for sizing and rating heat exchangers.

CO2: Understand able to apply single phase forced convection correlations in designing of heat exchangers.

CO3: Understand able to apply concept of pumping power and fouling factor in designing of heat exchangers

CO4: Understand and able to design double pipe and shell & tube heat exchangers.

CO5: Able to design phase change and compact heat exchangers and also understand its performance evaluation.

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Text book [TB]:

1. Kakac, S. and Liu H. "Heat Exchangers: Selection, Rating and Thermal Design", CRC Press, 2nd edition, 2002
2. Arthur P. Fraas, Heat Exchanger Design, John Wiley & Sons, 20-Mar-1989

REFERENCES [RB]:

1. Shah, R. K. and Sekulic, D. P., "Fundamentals of Heat Exchanger Design", John Wiley & Sons, Inc., 2003.
2. Webb, R.L., and Kim, N.H., "Principles of Enhanced Heat Transfer", Taylor and Francis, 2005.

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Applicable for 2017-2021

Subject Code	ME352	Subject Title	Tribology						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

Course Objective:

- To know about properties of lubricants, modes of lubrication, additives etc.
- To select suitable/proper grade lubricant for specific application.
- To select suitable material combination for tribological contact.
- To apply the basic theories of friction, wear and lubrications about frictional behavior commonly encountered sliding surfaces.

Course Pre/Co- requisite (if any): Fluid Mechanics and Fluid Machines, Design of Machine Elements

Detailed Syllabus

UNIT 1: Introduction

Tribology definition. Tribology in design- bearing material its properties and construction Tribological characteristics of oil seals and gasket. Tribology in industry (Maintenance).

Lubrication-Definition, basic modes of lubrication, properties of lubricants, additives, EP lubricants, Recycling of used oil, oil conservation. Bearing Terminology-Types of Sliding contact, rolling contact bearings. Comparison between sliding and rolling contact bearing. (Theoretical treatment only).

UNIT 2: Friction and wear

Introduction, laws of friction, Friction classification, causes of friction. Theories of dry friction. Friction measurement. Stick-slip motion and friction instabilities.

Wear-classification, wear between solids, wear between solid and liquids, factors affecting wear. Theories of wear. Wear measurement. Controlling friction.

UNIT 3: Hydrodynamic lubrication

Theory of hydrodynamic lubrication, mechanism of pressure development in oil film. Two dimensional Reynold's equation and its limitations, Petroff's equation. Designing journal Bearing. Hydrodynamic thrust bearing-Introduction, types. Flat plate thrust bearing-Pressure equation, load, centre of pressure.

UNIT 4: Hydrostatic lubrication and Gas (Air) lubrication

Hydrostatic lubrication-Basic concept, advantages, limitations, viscous flow, load carrying capacity, flow requirement of hydrostatic step bearing, energy losses, design concepts of stepped bearing. Squeeze film lubrication- Basic concept, circular and rectangular plate approaching a plane.

Gas(air) lubricated bearings-Introduction, advantages, disadvantages, applications of tilting pad bearing, hydrostatic and hydrodynamic bearing with air lubrication.

UNIT 5: Tribological Aspects

Lubrication in rolling, forging, drawing and extrusion. Theory of tyre road interaction, road grip. Surface engineering for wear and corrosion resistance-diffusion, plating and coating methods.

Learning Outcome:

CO1: Student develops confidence in him/her to fulfill course objectives.

CO2: Term work includes simple case study/assignment/seminar/visit and in-semester theory examination as a part of learning process encourages students.

CO3:He/she proves himself/herself to be excellent practical engineer in any tribological industry.

Text book [TB]:

1. Bharat Bhushan, — Principles and Applications of Tribology, 2nd Edition, Wiley India 2006.
2. Halling J., —Principles of Tribology||, McMillan Press Ltd.2010

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References [RB]:

1. Cameron A., —Basic Lubrication Theory||, Wiley Eastern Ltd.2012
2. Mujumdar B. C., —Introduction to Tribology and Bearings||, S. Chand and Company Ltd. New Delhi.2010
3. Fuller D. D., —Theory and Practice of Lubrication for Engineers||, John Wiley and Sons.2016
4. Halling J., —Principles of Tribology||, McMillan Press Ltd.
5. Bhushan B. and Gupta B. K., — Handbook of Tribology: Material, Coatings and SurfaceTreatments||, McGraw Hill Ltd.2015
6. Davis J., —Surface engineering for Corrosion and Wear Resistance||, Woodhead Publishing, 2001.
7. Tadausz Burakowski, —Surface Engineering of Metals: Principles, Equipments andTechnologies||, Taylor and Francis.2010

List of Experiments:

1. Experiment to study the pressure distribution in a journal bearing setup.
2. Experiment for Viscosity measurements of lubricating oil and other parameters.
3. Experiment for Topography of engineering surfaces and its description using optical methods.
4. Experiment for Wear measurements using Tribometer.
5. Measurement of surface roughness.

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Subject Code	ME353	Subject Title	Vehicle Maintenance						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

Course Objective: To make the student understand the need for vehicle maintenance and its importance and to familiarize the maintenance procedure for various components of an automobile.

Course Pre/Co- requisite (if any): Basic Automobile Engineering

Detailed Syllabus

UNIT 1: Inspection Schedule and Maintenance of Records

Need for maintenance, types of maintenance: preventive and breakdown maintenance, requirements of maintenance, preparation of check lists. Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance: General safety, tool safety.

UNIT 2: Vehicle Maintenance Tools and Equipments

Figs and Specifications of standard tools; non Standard tools; denting tools; painting equipment; testing equipment; Service station equipment; Hydraulic lift; Tyre changer; Tyre inflation gauge; Car Washer; Air Compressor; Spark Plug Cleaner and Tester; brake and transmission bleeding equipment; Grease Guns; Hydraulic Hoist; Analyzers: CO; HC; NOx; smoke meter: Engine analyzer: Petrol and Diesel; Ignition timing light; Wheel Balancer; Wheel aligner; Headlight aligner; Cylinder boring and honing; crankshaft grinder; Brake lathe m/c; ridge cutter and boring m/c; Trolley Jacks; Engine lifting cranes

UNIT 3: Engine Tuning

Procedure for carburetor based S.I Engine tuning; use of compression gauge; vacuum gauge; engine analyzer; exhaust analyzer; battery tester S.G tester; adjustment of spark plugs electrodes; Cam-dwell angle; valve tappet clearance; CB point; carburetor cleaning; air filter cleaning; replacement of engine oil and filter; ignition timing setting by timing light; tightening head bolts. Tyre inflation pressure; checking fuel consumption; MPFI and CRDI Engines: Study of tools needed to service the system: assembly line diagnostic link (ALDL) connector; ALDL read out scan tool; test light; ohmmeter; digital volt meter; jumper wires; vacuum gauge; Tachometer; computerized automotive maintenance system. Knowledge of diagnostic codes; service engine soon (SES) light; ECM; CALPAK. Study of important components : name; location and functions : TPS; IAC valve; ECM; MAP sensor; engine coolant temp sensor; IAT sensor; VSS; camshaft and Crankshaft – position sensor; start signal; PSP switch; Oxygen sensor; Fuel Vapor Canister; Catalytic Converter; Particulate filter; Troubles and diagnosis MPFI engines.

UNIT 4: Engine Maintenance

Tools used for engine disassembly, dismantling of engine components: cylinder head, valve train, cylinder block, connecting rod, piston and crankshaft assembly; cleaning and inspection of engine components, reconditioning of components. Cooling system: water pump, radiator, thermostat. Lubrication system maintenance, Anticorrosion and anti-freeze additives

UNIT 5: Chassis Maintenance

Servicing and maintenance of clutch, gear box, universal joints, propeller shaft, differential system. Service and maintenance of brake – disc and drum brakes, steering wheel and suspension systems, wheel alignment, vehicle body maintenance

Learning Outcome

After completing this course

CO1: The students can inspect and diagnose the problems occurring in the various components of the vehicle.

CO2: Student will get the industrial knowledge about the basic terminology and application.

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CO3:students will understands the maintenance issue related to engine and chassis.

Text book [TB]:

1. Shrivastava, Sushil Kumar., “Industrial Maintenance Management”, S Chand & Company Ltd., 2005
2. Knott and Phil Knott, “An Introductory Guide to Motor Vehicle Maintenance: Light Vehicles”, EMS publishing, 2010

REFERENCES [RB]:

1. Kholi.P.L. “Automotive Chassis and Body”, Tata McGraw-Hill Co., Ltd., New Delhi, 1975.
2. Tim Giles, “Automotive service: Inspection, maintenance and repair”, 3rd edition, 2007
3. Service manuals of various OEMs

List of Experiments:

1. Study of Automobile Repair Shop with the help of Layout.
2. Study and Preparation of Workshop Statements.
3. Experimental Study about Tools and instruments used in the maintenance shop.
4. Experiment to perform tuning of automobile multi cylinder engine.
5. Study and diagnosis of ignition, starting and charging system.
6. Study and diagnosis of Automobile fuel systems, filters & air cleaners
7. Wheel Balancing and adjustment of head light.
8. Adjustment of pedal play in clutch brake, hand brake and steering wheel and Braking system troubleshooting.

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Subject Code	ME354	Subject Title	Computer Aided Design (CAD)						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

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

Course Pre/Co- requisite (if any): Machine Drawing and Solid Modeling

Detailed Syllabus

UNIT 1:

Fundamentals of CAD: Introduction, Reasons for implementing a CAD system, Computer Aided Process application, conventional design vs CAD.

Computer graphics:

Graphics input devices-cursor control devices, digitizers, scanners and touch panels.

Graphics display devices: CRT, Color CRT monitors, DVST, Flat panel display, graphics output devices.

UNIT 2:

Line Drawing algorithms: Bresenham's line drawing and Mid-Point

Circle algorithms.

Geometric Modeling of Curves Types of mathematical representation of curves, wire frame models, wireframe entities, and parametric representation of synthetic curves- her mite cubic splines, Bezier curves, B-splines rational curves.

UNIT 3:

Introduction to Geometric Modeling of Surfaces and Solids Surface entities utilized in CAD.

Solid modeling, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG).

Graphics Standards: PHIGS, IGES, PDES. Standards in CAD.

UNIT 4:

Transformations (2D)

Transformations in CAD modeling software.

UNIT 5:

Finite Element Methods: Introduction and Application of FEM, Stiffness Matrix/ Displacement Matrix, One/Two Dimensional bar & beam element (as spring system) analysis

Learning Outcome

After completing this course, the students can:

CO1: Appreciate the importance of Computers in Product Design and Development Process.

CO2: Understand the prevalent display technologies.

CO3: Understand the modeling of CAD geometric elements.

CO4: Can use CAD software for modeling mechanical components

CO5: Students will be able to design and conceive new concepts of the state of art

Text book [TB]:

1. Ibrahim Zeid, Mastering CAD CAM, Tata McGraw Hill Publishing Co. 2007.
2. C. McMohan and J. Browne, CAD/CAM Principles, II edition, Pearson Education, 1999.

REFERENCES [RB]:

1. W. M. Neumann and R.F. Sproul, Principles of Computer Graphics, McGraw Hill, 1989.

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2. D. Hearn and M.P> Baker, Computer Graphics, Prentice Hall Inc., 1992

LIST OF EXPERIMENTS:

1. Introduction to CAD, CAE and Creo; Concepts: - Modelling, Parametric, Associative, Feature and Graphic User Interface of Creo Parametric, Sketcher, line center line and rectangle. (Practice module 1 and 2)
2. Circle: using centre and point, concentric circles, 3 point circle, 3 tangents circle, Ellipse: axis end ellipse, center and axis, Arc: 3-point/Tangent end, center and ends, 3 tangents, concentric, conic (Practice module 3)
3. Dimensioning the sketch: Normal dimensions, reference dimensions, perimeter and baseline dimensions Fillets & trim: Circular and elliptical, Chamfer: chamfer and chamfer trim Spline, Point, Coordinate system, text, Palette (practice module 4)
4. Part Modelling: Part mode, setting units, Creating reference sketch, Extrude: Blind, side1, side2, symmetric, to next, through next, to selected (Practice module 5 & 6)
5. Revolve: selecting axis, thin features, Sweep: Selecting profile and path, free and merge ends, thin protrusion, surface sweep, Helical Sweep: defining path and profile, Draft: selecting draft surface, hinges, pull direction, draft angle. split draft, draft sides independently, first side only, second side only, Hole: placement of hole, sketched holes, standard holes (practice module 7 & 8)
6. Rounds: Sets, transitions, Chamfer: chamfer sets, transitions and corner chamfer (Practice module 9 & 10)
7. Datum planes: normal to plane, parallel, offset, tangent constraint, Datum axis: normal, through constraint, Datum Points: on a plane or face, offset to face, intersection of three faces, centre of curve edge, Datum curves: through points, by sketching (practice module 11 & 12)
8. Shell: surface selection, Patterns, Ribs and introduction to assembly design (Practice module 13)

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Subject Code	ME355	Subject Title	Design For Manufacturing						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

Course Objective To provide the basic knowledge and understanding of the concept & role of Design in manufacturing.

Course Pre/Co- requisite (if any): Manufacturing Process, Industrial Engineering and Management

Detailed Syllabus

UNIT 1: Introduction

Concepts of DFM, Role of DFM, Material and Process Selection

UNIT 2: Components Design

Design for Quality, Design for Assembly, Design for Cost, Design for Performance, Design for Biocompatibility, Design for Ergonomics, Design for Recycling and other factors.

UNIT 3: Methods of Material Selection

Material Selection on the basis of Engineering Properties, Material Selection on the basis of material performance indices, Material Selection on the basis of charts, Evaluation of single and multi-attribute utilities

UNIT 4: Design Rules

Design rules for material and process, Part geometry and tolerances, Shape factor, Prototyping, Computer aided Material, Functional Modelling, Mathematical optimization, Formation of objective, Constraint functions, factorial analysis.

UNIT 5: Case Studies

Case studies on product design. Case study on manufacturing design. Case study on design of assembly.

Learning Outcome:

After completing this course, the students can:

- CO1: Design different components/parts for manufacturing.
- CO2: Identify application of different materials.
- CO3: Apply proper rules and criteria for designing of a component.
- CO4: Design components for industrial applications

Text book [TB]:

- Design for Assembly Automation and Product Design by G. Boothroyd, Marcel Dekker.2010
- Engineering Design and Design for Manufacture and Structural Approach by Dickson, John. R, and Corroda Poly 2016

References [RB]:

- Material Selection in Mechanical Design by Michael Ashby.2006
- Design for Manufacture handbook, McGraw Hill by Bralla 1999.

List of Experiments:

- Case Studies

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Subject Code	ME356	Subject Title	Automotive Fuel And Lubricants (AFL)						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

Course Objective: To provide an overview of fuels/lubricants and their distillation, discussing various parts of automobile which are involved in the use of lubrication.

Course Pre/Co- requisite (if any): Basic Thermodynamics, Fluid Mechanics

Detailed Syllabus

UNIT 1:

Structure of petroleum, refining process, Fuels, thermal cracking and catalytic cracking, Polymerization, alkylation, isomerization, blending, Products of refining process, manufacturing of lubricating oil base stocks, Lubricating finished automotive lubricants.

UNIT 2:

Engine friction-introduction, Total engine friction and effects of engine variables on friction, Hydrodynamic lubrication, Elasto-hydrodynamic lubrication and boundary lubrication, Bearing lubrication and functions of lubrication system, Properties of lubricants.

UNIT 3:

Specific requirements of automotive lubricants, oxidation deterioration, Degradation of lubricants and Additives, Additive mechanism and synthetic lubricants, Classification of lubricating oils, Tests on lubricants, Grease, classification and properties, Tests used in grease

UNIT 4:

Thermos-chemistry of fuels, Properties and testing of fuels, Relative density, calorific value, flash point and fire point, distillation, Vapor pressure, spontaneous ignition temperature, viscosity and pour point, Flammability, ignitability, diesel index, API index, Aniline point, carbon residue, copper strip corrosion.

UNIT 5:

SI engines-flame propagation and mechanism of combustion, Normal combustion, knocking, octane rating and fuel requirements, CI engines- mechanism of combustion, diesel knock, Cetane rating and fuel requirements, Additive mechanism, requirements of an additive, Petrol fuel additives and diesel fuel additives-specifications of fuels

Learning Outcome

After completing this course, the students would be able to-

CO1: Understand about the origin and formation of different kind of fuels/lubricants.

CO2: Understand the different methods of separation of lubricants from crude oil.

CO3: Come out with some basic understanding of journal bearings.

CO4: Understand about the various properties of the lubricants used in the daily use vehicles.

CO5: Get the basic idea about the chemistry behind the formation of the lubricants.

Text book [TB]:

1. Ganeshan. V., "Internal Combustion Engineering", Tata McGraw-Hill Publishing Co., New Delhi, 2003.
2. Mathur M.L., Sharma R.P., "A course in Internal Combustion Engines", Dhanpatrai Publication, 2003
3. Obert E.F., "Internal Combustion Engineering and Air Pollution", International book co., 1988.

References [RB]:

1. NPTEL
2. Brame, J.S.S. & King J.G., "Fuel Solids, Liquids, Gaseous", Edward Arnold, 1961
3. Francis W., "Fuels and Fuel Technology, Vol 1 & 2, Pergamon, 1965
4. Hobson G.D. & Pohl, "Modern Petroleum Technology", 1974
5. Raymond C. Gunther, "Lubrication", Chilton Book Co., 1971.

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List of Experiments:

1. Abel's Flash point apparatus
2. Aniline point temperature calculation
3. ASTM distillation apparatus for the calculation of condensate of fuel sample
4. Bomb Calorimeter apparatus for the calculation of HCV and LCV
5. Carbon Residue calculation for a given sample
6. Cleveland Flash point and Fire point apparatus
7. Calculation of drop melting point temperature
8. Pensky Martin apparatus for the flash and fire point temperature calculation
9. Redwood viscometer-I for the calculation of viscosity of a fuel sample.
10. Redwood viscometer-II for the calculation of viscosity of a fuel sample.
11. Saybolt viscometer for the calculation of viscosity of a given sample.

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Subject Code	ME357	Subject Title	Computational Fluid Dynamics						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

Course Objective: To provide the students with sufficient background to understand the mathematical representation of the governing equations of fluid flow and heat transfer. To enable the students to solve one and two-dimensional ordinary and partial differential equations using traditional CFD tools.

Course Pre/Co- requisite (if any): Basic Thermodynamics, Fluid Mechanics, Engineering Mathematics

Detailed Syllabus

UNIT 1: Introduction and Governing Equations

Introduction- Impact and applications of CFD in diverse fields - Governing equations of fluid dynamics – Continuity - Momentum and energy - Generic integral form for governing equations - Initial and Boundary conditions - Governing equations for boundary layers - Classification of partial differential equations – Hyperbolic - Parabolic - Elliptic and Mixed types - Applications and relevance.

UNIT 2: Discretization

Basic aspects of discretization - Discretization techniques – Finite difference - Finite volume and Finite Element Method– Comparison of discretization by the three methods -Introduction to Finite differences - Transient one-dimensional and two-dimensional conduction – Explicit - Implicit - Crank-Nicolson - ADI scheme – Stability criterion.

Difference equations - Numerical errors - Grid independence test - Optimum step size.

UNIT 3: Grid Generation

Grid generation – General transformation of the equations - Form of the governing equations suitable for CFD – Boundary fitted co-ordinate systems – Elliptic grid generation - Adaptive grids – Modern developments in grid generation.

UNIT 4: Convection – Diffusion

Steady one-dimensional convection and diffusion - Central difference, upwind, quick, exponential, false diffusion, hybrid and power law schemes. Transient one-dimensional heat conduction equation.

UNIT 5: Calculation of Flow Field

Representation of the pressure - Gradient term and continuity equation – Staggered grid -Momentum equations - Pressure and velocity corrections - Pressure Correction equation -Numerical procedure for SIMPLE algorithm - Boundary conditions for the pressure correction method. Stream function – Vorticity method - Discussion of case studies.

Learning Outcome

After completing this course, the students can:

- CO1: Possess the knowledge of CFD techniques, basic aspects of discretization and grid generation.
- CO2: Solve fluid flow fields using CFD methods.
- CO3: Model fluid flow problems and heat transfer.
- CO4: Apply explicit, implicit and semi-implicit methods of finite differencing.

Text book [TB]:

1. K.A. Hoffman, (2000), Computational Fluid Dynamics for Engineering, Vol I – III Engineering Education System, Austin, Texas.

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2. H. Versteeg (Author), W. Malalasekera, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Second Edition. 2006

References [RB]:

1. J.D. Anderson, Jr., (2000), Computational Fluid Dynamics – The basics with applications, McGraw-Hill, Inc.
2. K. Muralidhar, T. Sundarajan, (2001), Computational Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi. 2010
3. S.V. Patankar, (1999), Numerical Heat Transfer and Fluid Flow, Hemisphere, New York.
4. V.V. Ranade, (2002), Computational Flow Modeling for Chemical Reactor Engineering, Academic Press

List of Experiments:

1. Diffusion/Conduction Problem
2. Convection-Diffusion Problem
3. Pressure-Velocity Coupling Problem
4. Unsteady flow
5. Complex geometry and boundary conditions problem
6. Turbulence Flow Simulation
7. Calculate the velocity at 0.005m from inlet- Without using Turbulence model.
8. Calculate the velocity at different points 0.0, 0.01, 0.03, 0.05, 0.07, 0.09 & 0.1m from inlet- Using k- ϵ Turbulence model.
9. Calculate the velocity at different points 0.0, 0.01, 0.03, 0.05, 0.07, 0.09 & 0.1m from inlet- Using k- ω Turbulence model.

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Subject Code	ME358	Subject Title	IC Engines						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

Course Objective: This course provides a basic skill for understanding of construction of automobile engines working principle and performance under various conditions.

Course Pre/Co- requisite (if any): Basic Thermodynamics

Detailed Syllabus

UNIT 1: Fuel Supply Systems for SI Engine:

Engine classification, Ideal air standard cycles & actual air standard cycles analysis, Valve timing diagram, Air fuel ratio requirements of SI engines, Requirements of an automotive carburetor; Working of a simple fixed venture carburetor, Fuel feed systems, MPFI systems for petrol.

UNIT 2: Fuel Supply Systems for CI Engine:

Diesel fuel injection systems, Air and solid injection, Jerk pumps, distributor pumps, Unit injector, Fuel injector - pintle and multi-hole nozzles, CRDI systems for diesel, Fuel injection computation.

Emissions from Internal Combustion Engine and its Control

Spark Ignition and Compression Ignition Engine Emissions, Effect of emissions on Human Health and Environment, Control of engine emissions - Catalytic Converter, EURO and BHARAT norms.

UNIT 3: Combustion, Supercharging and Turbocharging:

Introduction to combustion in SI and diesel engines and stages of combustion. Knock in SI and CI engines. Effect of engine variables and knock. Combustion chambers for SI and CI engines. Importance of Swirl, squish and turbulence. Factors controlling combustion chamber design

Supercharging and Turbocharging: Necessity and limitation, Different methods of turbocharging.

UNIT 4: Cooling and Lubrication System:

Need for cooling, types of cooling systems- air and liquid cooling systems. Thermosyphon and forced circulation and pressurized cooling systems. Properties of coolants. Requirements of lubrication systems. Types-mist, pressure feed, dry and wet sump systems. Properties of lubricants.

UNIT 5: Engine Testing and Performance Characteristics:

Dynamometers, indicated thermal, brake thermal and volumetric efficiencies. Measurement of friction, Cylinder pressure measurement. Engine performance curves, Engine testing standards. Variables affecting engine performance. Methods to improve engine performance. Heat balance sheet.

Non-Conventional Internal Combustion Engines

Stratified Charged Engine, Wankel Engine, Free Piston Engine, Stirling Engine, Variable Compression Ratio Engine, Dual Fuel Engines, Multi Fuel Engines

Learning outcomes:

After completing this course, the students can:

CO1: Understand the basic working principles of engines, its Construction and Operation.

CO2: Understand phenomena of Combustion and Design of Combustion Chambers.

CO3: Conduct Engine Testing and Performance and understand Performance characteristics.

Text book [TB]:

1. V. Ganesan, "Internal Combustion Engines", Tata Mc Graw Hill Publishers, 4th Edition.2016
2. M.L. Mathur & R. P. Sharma," A Course in International Combustion Engines", Dhanpat Rai & Sons. 4th Edition, 2005.

References [RB]:

1. Colin R. Ferguson, Allan Thomson Kirkpatrick, "Internal combustion engines" John Wiley & Sons, 2nd edition, 2000.
2. Automotive Engines by E. H. Ellinger, Prentice Hall Publishers, 1992.
1. Study & experiment on 2- Stroke diesel and diesel engine.

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2. Study & experiment on 4- Stroke petrol and diesel engine.
3. Performance Analysis of Four stroke S.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
4. Determination of Indicated H.P. of I.C. Engine by Morse Test.
5. Performance Analysis of Four stroke C.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
6. Study & experiment on Ignition system of I.C. Engine.
7. Study & experiment on Fuel Supply System of S.I. Engines- Carburetor, Fuel Injection Pump and MPFI.
8. Study & experiment on Fuel Supply System of C.I. Engines- Injector & Fuel Pump.
9. Experiment on Exhaust Gas Analysis of an I.C. Engine.
10. Demonstration and study of commercial exhaust gas analyzers.

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Subject Code	ME359	Subject Title	Computer Integrated Manufacturing						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

Course Objective: Introduce student to (mechanical) measurement techniques so as to appreciate relationship between process and system in manufacturing domain for identifying techniques for quality assurance of process.

Course Pre/Co- requisite (if any): Manufacturing Process

Detailed Syllabus

UNIT 1:

Introduction- Concepts of CIM, Manufacturing system, components of CIM, CASA/SME model of CIM, CIM II, Benefits of CIM, Communication matrix in CIM, Fundamentals of computer communication in CIM, computer networking in CIM- seven layers of OSI model.

UNIT 2:

NC & CNC part programming: Fundamental of NC technology, computer numerical control, distributed numerical control, coding systems and formats, Manual NC part programming, Examples drilling and milling, turning, CNC machines and turning centers, CNC part programming.

UNIT 3:

Material Handling System -introduction to material handling, material transport equipment like industrial trucks, automated guided vehicles, monorail and other rail guided vehicles, conveyors, cranes and hoists.AS/RS design process
Identification technologies- introduction, bar code technology, radio frequency identification.

UNIT 4:

Flexible manufacturing systems: introduction, FMS components, equipment's, FMS tool Management systems, system layout, FMS control, case study. FMS applications and benefits.
Group technology and cellular Manufacturing: part families, part classification and coding Production flow analysis, application of Group technology.

UNIT 5:

Process planning and Concurrent Engineering- process planning, computer aided process planning, concurrent engineering and design for manufacturing, advance manufacturing planning,
Production Planning and Control systems- Aggregate production planning and the Master Production Schedule, Material Requirement planning, Shop floor control, Inventory control, JUST IN TIME, Lean and Agile manufacturing.

Learning Outcome

At the end of the course the student can:

- CO1: Identify measuring process, appropriate measuring tools for various manufacturing /shapes/ processes
- CO2: Relate metrology parameters in manufacturing processes to dimensional accuracy, tolerances of products
- CO3: Attain a hands on approach to practical measurements related to sensor based technology
- CO4: Relate to overall optimization in manufacturing domain; relationship between processes and system
- CO5: Identify techniques for the quality assurance of products in terms of process & resource management

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Text book [TB]:

1. Groover. Mikell P, "Automation, Production systems and computer integrated manufacturing", Third edition, PHI learning private limited, ISBN-978-81-203-3418-2.
2. Rao P N, "CAD/CAM Principles and Applications "third edition, McGraw Hill Education Pvt. Ltd. ISBN-978-0-07-068193-4

References [RB]:

1. Groover. Mikell P and Zimmers jr. Emory, "CAD/CAM", Prentice hall of India Pvt Ltd., 1998.
2. James A, Regh and Henry W. Kreabber "Computer integrated manufacturing" Pearson Education second edition, 2005.
3. Paul G. Ranky., "Computer Integrated Manufacturing", Prentice hall of India Pvt Ltd., 2005

Experiments:

1. Study of Flexible manufacturing system
2. Writing a part-programming (in word address formator in APT) for a job for turning operation and running on NC machine.
3. Writing a part-programming (in word address formator in APT) for a job for drilling operation (point-to-point) and running on NC machine.
4. Writing a part programming (in word address format or in APT) for a job for milling operation (contouring) and running on NC machine
5. Experiment on Robots and it programs
6. Experiment on Transfer line/Material handling (AS/RS).
7. Experiment on difference between ordinary machine and NC machine.

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Subject Code	ME370	Subject Title	Automobile Component Design						
LTP	3 1 0	Credit	4	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

Course Objective: This subject will make students well versed with concept of design of different components like piston, gear, gearbox, piston pin, connecting rod, crank shaft, cylinder liner, flywheel, valve mechanism etc. and how to standardize this design

Course Pre/Co- requisite (if any): Basic Automobile Engineering, Design of Machine Elements

Detailed Syllabus

UNIT 1: Design of Gears

Types of gears, Design consideration of gears, material selection, Types of gear failures, Gear lubrication.

Helical Gears: Virtual number of teeth, Tooth proportions, Force analysis, Beam strength of helical gears, Effective load on gear tooth, Wear strength of helical gears, Design of helical gears

Bevel Gears: Terminology of bevel gears, Force analysis, Beam strength of bevel gears, Wear strength of bevel gear, Effective load on gear tooth, Design of bevel gear.

Worm Gears: Force analysis, Friction in worm gear, Vector method, Strength rating of worm gears, Wear rating of worm gear.

UNIT 2: Design of Gearbox

Design considerations of gearbox, selection of proper gear ratios for an automobile gearbox, design of shafts, splines, and gears for gear box used in automobiles.

UNIT 3: Engine and Piston

Engine power requirements, Selection of engine type, Stroke & Bore, compression ratio, clearance volume and swept volume, mean piston speeds.

Design of Piston & Piston pin: Materials used, design of piston crown, pin dimensions.

UNIT 4: Crank, Connecting Rod and Cam Shaft

Design of Crank shaft & Connecting Rod - Forces, material, types, design criteria, dimensions etc.

Design of main journal bearing pin and connecting rod bearing pin of Crank shaft.

Main journal bearing and connecting rod bearing (small end & big end), Cam shaft bearings: Bearing materials, design criteria, types and dimensions.

UNIT 5: Cylinder Block and Valves

Cylinder block dimensions, Types of liner–Dry & Wet type.

Valve mechanism Design: Valve, rocker arm, Valve spring design, Push rod, cam shaft and cam follower etc.

Design of cylinder head: Stresses, materials, Combustion chamber design.

Selection of Engine layouts.-Design Criteria of intake manifold and exhaust manifold.

Learning Outcome

At the end of the course the student can:

CO1: Demonstrate knowledge and understanding of selection and designing of different automobile components.

CO2: Apply practical and theoretical knowledge to standardize different parts.

CO3: Students will get the information about various components of automobile.

Text book [TB]:

1. Transmission System Design by R. B. Patil, Tech Max Pub, Pune.2006
2. Elements of Motor Vehicles Design by D T Bdonkins, TMH, 2010

Reference Books [RB]:

1. Automotive Mechanics by N. K. Giri, Khanna Publishers, 2006
2. Auto Design by R. B. Gupta, Satya Prakashan, 2010

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Applicable for 2017-2021

Subject Code	ME371	Subject Title	Automobile System Design						
LTP	3 1 0	Credit	4	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

Course Objective: To make student get acquainted with to standardize the automobile part after designing the system component like clutch, propeller shaft, axle, steering linkages, braking parts, suspension system etc. within the space limitations and optimize it.

Course Pre/Co- requisite (if any): Basic Automobile Engineering, Design of Machine Elements

Detailed Syllabus

UNIT 1: Design of Propeller Shaft

Design of propeller shaft for bending, torsion, rigidity and critical speed criteria. Design of universal joint and slip joint.

UNIT 2: Design of Clutch System

Design of various clutch system components (Single plate, multiple plates, centrifugal clutch, lining material) and Pressure Plate Assembly components. Hydraulic Clutch system components (Master Cylinder, Slave cylinder, reservoir) clutch fluid –its properties, hydraulic pipes. Clutch Pedal & Clutch hand lever design. Clutch cable Design / selection considerations

UNIT 3: Design of Braking System

Brake balance, Stopping distance, Brake fade, Work done in braking, Braking efficiency, Braking of vehicle, Braking of vehicle moving in a curved path, Design of drum brake, Design of disc brake, Design of hydraulic brake system, Design of hand brake or parking brake.

UNIT 4: Design of Axle

Front Axle beam, Steering Knuckle, King pin. Rear Axle (drive Axle) tube, Design of fully floating, half floating axle and dead axle. Design of Final drive and differential: Design of spiral bevel and hypoid type of final drive/differential.

UNIT 5: Design of Steering and Suspension System

Condition for true rolling, Turning circle radius, Principle of Ackermann steering, Ackermann-linkage geometry, Steering gear ratio, Steering box torque, Design of various steering gear box.

Design of Suspension System:

Function of suspension, Forces act on suspension, Suspension springs (laminated or leaf, coil, torsion bar, rubber spring, pneumatic spring), Design of laminated or leaf spring, Design of helical or coil spring, Design of torsion bar spring

Learning Outcome

At the end of the course the student can:

CO1: Demonstrate knowledge and understanding of selection and designing of different automobile systems.

CO2: Apply practical and theoretical knowledge to standardize different parts.

CO3: Optimize the parts for given situation.

Text book [TB]:

1. Transmission System Design by R. B. Patil, Tech Max Pub, Pune.2006
2. Automobile Engg. Vol-I & II by Kirpal Singh, Standard Pub.2010

Reference Books [RB]:

1. Automotive Mechanics by N. K. Giri, Khanna Publishers 2016
2. Auto Design by R. B. Gupta, Satya Prakashan 2006

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Applicable for 2017-2021

Subject Code	ME372	Subject Title	Vehicle Dynamics						
LTP	3 1 0	Credit	4	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

Course Objective: To make student understand dynamic behavior of different systems in different loading condition in automobile vehicle

Course Pre/Co- requisite (if any): Advanced Automobile Engineering, Design of Machine Elements

Detailed Syllabus

UNIT 1: Introduction to Vehicle Dynamics

History, vehicle classifications, fundamental approaches to vehicle dynamics modelling; SAE Vehicle axis system, Forces & moments affecting vehicle, Earth Fixed coordinate system, Dynamic axle loads, Equations of motion, transmission characteristics, vehicle performance, power limited and traction limited acceleration, braking performance, Brake proportioning, braking efficiency.

UNIT 2: Acceleration and Braking Performance

Power train components; power and traction limited acceleration; transverse weight shift; front wheel drive vs rear wheel drive vs. all-wheel drive vehicles.

Braking force analysis; brake design and analysis; federal regulation on braking performance; antilock braking system; wheel lock-up; tire/road friction; safety and maintenance issues in braking.

UNIT 3: Road Loads and Tire Dynamics

Wind drag and car body design, rolling resistance; breakdowns of total road loads; gas mileage analysis and driving styles; Aerodynamics

Tire specifications and constructions; tire motion analysis; tire force analysis; tire contact stress analysis; tire vibration analysis; tire models

UNIT 4: Cornering, Chassis and Suspension Systems

Riding comfort; perception of vibration; vibration sources; vibration transmission to the passengers; lower speed cornering; high speed corner; cornering bicycle model; Quasi-Static Rollover of a Rigid Vehicle, Quasi-Static Rollover of a Suspended Vehicle, Transient Rollover.

Chassis and Suspension Systems

Suspension Kinematics, Suspension types, Solid Axles, Independent Suspensions, Anti-Squat and Anti-Pitch Suspension Geometry, Anti-Dive Suspension Geometry, Roll Center Analysis, Suspension Dynamics, Multi-body vibration, Body and Wheel hop modes, Invariant points, Controllable Suspension Elements: Active, Semi-Active. Choice of suspension spring rate, Calculation of effective spring rate, Vehicle suspension in fore and aft directions.

UNIT 5: Motorcycle Dynamics

Kinematic structure and geometry of motorcycles, importance of trail, Resistance forces acting on motorcycle (tyre rolling and aerodynamic resistance forces, resistant force caused by slope), Location of motor cycle's centre of gravity (C.G), Moments of inertia on Motorcycle.

Learning Outcome

At the end of the course the student can:

CO1: Address the underlying concepts and methods behind Vehicle Dynamics.

CO2: Present a problem oriented in depth knowledge of Vehicle Dynamics.

CO3: understanding of Industrial terminology about vehicles.

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Text book [TB]:

1. Fundamentals of Vehicle Dynamics, Thomas Gillespie, SAE Publication 2001
2. The Multibody systems Approach to Vehicle Dynamics, Mike Blundell and Damian Harty, Elsevier, 2004.

Reference Books [RB]:

1. Hans Pacejka, Tire and Vehicle Dynamics, Elsevier, 2012.
2. Rajesh Rajamani, Vehicle Dynamics & control, Springer.2006
3. R.V. Dukkipati, Vehicle dynamics, Narsova Publications.2010

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Subject Code	ME363	Subject Title	Industrial Ergonomics						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	4 th	Semester	VI

Course Outline:

Course Objective: This course provides an overview on principles of ergonomics and human factors, their applications to the design and management of industrial systems, Engineering anthropometry, Human performance, human-technology interaction, work place and work station design. The emphasis is on how methods are used to study, improve and optimize designing a product or industrial system.

Course Pre/Co- requisite (if any): ME345

Detailed Syllabus

UNIT 1: Human Physical Characteristics, Ergonomics and Human Factors Engineering, person machine system, cognitive core, work-space shell, Physiology of Work, Cognitive Psychology and Sensory Processes, Biomechanics and Engineering.

UNIT 2: Engineering Anthropometry, Human Machine System, Machine and Tool Design, Visuals displays, Auditory and textile display.

UNIT 3: Work Place and Work Station Design, Work Design, Fundamentals of Physical Working Environment, Information Technology, body measurement, safety and related corners, physical ability, Work station in health caring system.

UNIT 4: Office Systems and Ergonomics, Ergonomics of Technology Management.

UNIT 5: Consumer Ergonomics, Ergonomics Quality and Safety, Quality of Life

Learning Outcome

At the end of the course the student can:

CO1: Specify and design ergonomically appropriate industrial workstations for the industrial and office work environment.

CO2: Identify information-centered human factors relating to visual, illumination, controls, displays and symbols.

CO3: Compare, contrast and assess human body-centered ergonomic designs for posture, material handling, repetitive motion factors, heat stress, noise and vibration.

CO4: Define the ergonomic factors intrinsic in evaluating accidents, human errors and safety related incidents.

CO5: Illustrate and assess the ergonomic factors in computer work station design. Discuss and identify key components of cost-benefit analysis in human factors and ergonomic design.

CO6: Summarize key components in conducting a human factors or ergonomics related investigation.

Text book [TB]:

1. Human Factors in Engineering and Design By Sanders & McCormick (McGrawHill Publication) 2010
2. Occupational Ergonomics – Principles and Applications By Tayyari & Smith (Chapman & Hall Publication) 2006

Reference books [RB]:

1. The Power of Ergonomics as a Competitive Strategy By Gross & Right (Productivity Press) 2010.
2. Martand Telsang, Industrial Engineering and Production Management, S. Chand & Compagny Limited, 2006.

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME373	Subject Title	Auto Pollution & Control						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

Course Objective: To make the students to realize the impact of automobile emissions on the environment and expose student to factors affecting formation and control of automobile pollutants and governing regulations

Course Pre/Co- requisite (if any): Engineering Chemistry, Environmental Sciences

Detailed Syllabus

UNIT 1: Introduction

Vehicle population assessment in metropolitan cities and contribution to pollution, effects on human health and environment, global warming, types of emission, transient operational effects on pollution, noise vibration and harshness (NVH).

UNIT 2: Pollutant Formation in Engines

Pollutant formation in Engines, mechanism of HC and CO formation in four stroke and two stroke engines, NOx formation in engines, smoke and particulate emissions in CI engines, effects of design and operating variables on emission formation, control of evaporative emission. Two stroke engine pollution.

UNIT 3: Control of Emissions from Engines

Design strategies to control emission from engines, optimum selection of operating variables for control of emissions, EGR, Thermal reactors, secondary air injection, catalytic converters, catalysts, fuel modifications, fuel cells, two stroke engine pollution control.

UNIT 4: Noise Pollution from Automobiles

Noise, Vibration And Harshness, Sources of Noise, Measurement of Noise –Engine Combustion Noise, Inlet And Exhaust Noise, Traffic Noise, Vehicle Body Noise – control of noise, control devices and noise proof materials.

UNIT 5: Measurement Techniques, Emission Standards and Test Procedure

NDIR, FID, Chemiluminescent analyzers, Gas Chromatograph, smoke meters, emission standards, driving cycles – USA, Japan, Euro and India. Test procedures – ECE, FTP Tests. SHED Test – chassis dynamometers, dilution tunnels – 3 Field Visits

Learning Outcome

At the end of the course the student can:

CO1: Understand the effect of air and noise pollution and agent causing it.

CO2: Control the emission from engine and diagnose the pollution causing parameter.

CO3: apply the different measurement techniques and arrive to different emission standards.

Text book [TB]:

1. Paul Degobert – Automobiles and Pollution – SAE International ISBN-1-56091-563- 1991.
2. Ganesan, V- “Internal Combustion Engines”- Tata McGraw-Hill Co.- 2003.
3. Beranek.L.L. “ Noise Reduction”, McGraw Hill Book co., Inc, New York, 1993. Tractor and Automobiles by Rodichev and G. Rodicheva, MIR Publishers, 1987.

Reference Books [RB]:

1. SAE Transactions- “Vehicle Emission”- 1982 (3 volumes).
2. Obert.E.F.- “Internal Combustion Engines”- 1988
3. Marco Nute- “ Emissions from two stroke engines, SAE Publication – 1998 Fundamentals of Vehicle Dynamics, Thomas Gillespie, SAE Publication
4. The Multibody systems Approach to Vehicle Dynamics, Mike Blundell and Damian Harty, Elsevier, 2004.

Course Structure of B.Tech. – Mechanical Engineering

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Applicable for 2017-2021

Subject Code	ME364	Subject Title	Renewable Energy Sources						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

Course Objective: To provide students an overview of global energy resources with focus on renewable energy sources and their importance in the context of limited supply of conventional energy resources & global warming.

Course Pre/Co- requisite (if any): Basic Thermodynamics, Heat Transfer

Detailed Syllabus

UNIT 1: ENERGY RESOURCES

Introduction: Energy & its importance in social & economic development; energy demand & supply, world energy status, energy scenario in India; energy & environment, greenhouse effect & global warming; role of renewable energy sources; a brief introduction to various renewable energy sources – hydro, solar, biomass, wind, geothermal & ocean energy – their availability & present status.

UNIT 2: SOLAR ENERGY

The sun as a source of energy, extraterrestrial & terrestrial solar radiation; solar radiation data & geometry, solar radiation on horizontal & inclined surfaces; solar thermal systems – various types of solar collectors & their applications in cooking, drying, water heating, distillation, space heating & cooling, refrigeration and power generation.

Solar photovoltaic systems, solar cell fundamentals, performance & characteristics, types of solar cells; solar cell, module, and array construction; solar PV applications.

UNIT 3: BIOMASS ENERGY

Origin of biomass, photosynthesis & generation of biomass, availability of biomass, usable forms of biomass – fuel wood, charcoal, fuel pellets, biodiesel, bioethanol, biogas and producer gas; biomass conversion technologies, thermochemical & biochemical methods, biomass gasification, classification & operational parameters of biogas plants, energy recovery from urban waste, sewage to energy conversion.

UNIT 4: WIND ENERGY

Origin & nature of winds; history of power from winds; global & local winds; estimation of wind energy at a site; maximum power extraction from wind – Betz criterion; capacity factor of wind power plants; types of wind turbines – horizontal and vertical axis wind turbines; wind energy storage; environmental & economic aspects; present status of wind energy systems.

UNIT 5: GEOTHERMAL & OCEAN ENERGY

Structure of earth's interior; origin & distribution of geothermal energy, types of geothermal resources – exploration & development of hydrothermal, geo-pressured & hot dry rock resources; electrical power generation from geothermal energy; environmental & economic considerations.

Ocean energy; tidal, wave & ocean thermal energy, energy from tidal streams (marine currents); technology for harnessing tidal & wave energy; ocean thermal energy conversion technology.

Learning Outcome

At the end of the course the student will:

CO1: Understand about the interaction between energy, economy, environment, and social development.

CO2: Appreciate the importance of renewable energy sources & future energy systems based on them.

CO3: Possess the basic technical knowledge to develop energy systems based on solar, biomass, wind, geothermal & ocean energy.

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

Text book [TB]:

1. B. H. Khan, “Non-Conventional Energy Resources”, 3rd edition (2017), McGraw Hill Education (India) Private Limited, Chennai.
2. S. P. Sukhatme & J. K. Nayak, “Solar Energy”, 4th edition (2018), McGraw Hill Education (India) Private Limited, Chennai.

References [RB]:

1. G. N. Tiwari & M. K. Ghosal, “Renewable Energy Resources – Basic Principles and Applications”, 2005, Narosa Publishing House, New Delhi.
2. D.P. KOTHARI, K. C. SINGAL, RAKESH RANJAN, Renewable Energy Sources And Emerging Technologies, PHI Learning Pvt. Ltd., 25-Nov-2011.

Course Structure of B.Tech. – Mechanical Engineering

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Applicable for 2017-2021

Subject Code	ME365	Subject Title	Nuclear Power Engineering						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

Course Objective:

Course Pre/Co- requisite (if any): Basic Thermodynamics, Heat Transfer

UNIT 1:

Energy & the world; Importance of nuclear energy; History of nuclear energy; Equivalence of matter & energy; Nuclear structure & stability; Radioactivity & laws of radioactive decay; Mass defect & binding energy; Nuclear fission & fusion reactions. Microscopic & macroscopic cross sections; Rates of binary nuclear reactions.

UNIT 2:

Types of nuclear reactors; Pressurized & Boiling water reactors; Heavy water reactors; High temperature gas cooled reactors; Breeder reactors; Generation IV reactors; Nuclear reactors for propulsion; Introduction to fusion reactors..

UNIT 3:

Neutron chain reaction; Concept of a critical reactor; One-group neutron diffusion theory of a bare nuclear reactor; critical size and mass; Multiplication constant and reactivity; Delayed neutrons; Lifetime & reproduction time of neutrons; Point reactor kinetics; Reactivity feedbacks; Fission product poisoning.

UNIT 4:

Heat generation in fuel elements & temperature distributions; Heat removal; Reactor coolants; Single phase & two-phase heat transfer; Boiling and flow regimes; Basic thermal hydraulic analysis of reactor core using heat transfer & fluid flow correlations. Decay heat removal & its importance for nuclear safety.

UNIT 5:

Introduction to nuclear fuel cycle; Nuclear fuel resources & uranium enrichment; Fuel fabrication; Spent fuel storage and reprocessing; Nuclear waste disposal; Economics of nuclear power.

Useful radioisotopes & their applications; Biological effects of radiation; Radiation protection.

Ocean energy; tidal, wave & ocean thermal energy, energy from tidal streams (marine currents); technology for harnessing tidal & wave energy; ocean thermal energy conversion technology.

Learning Outcome

At the end of the course the student will:

CO1: Describe and analyze different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.

CO2: Analyze the working and layout of Nuclear power plants and the different systems comprising the plant and discuss about its economic and safety impacts

CO3: Describe the working principle and basic components of the nuclear power plant and the economic and safety principles involved with it.

CO6: Discuss and analyze the mathematical and working principles of different electrical equipment involved in the generation of power.

Text book [TB]:

1. Mohamed Mohamed El-Wakil , Nuclear power engineering , McGraw-Hill, 1962.
2. Malcolm Joyce , Nuclear Engineering: A Conceptual Introduction to Nuclear Power, Butterworth-Heinemann, 18-Sep-2017.

References [RB]:

1. Viorel Badescu, George Cristian Lazaroiu, Linda Barelli , Power Engineering: Advances and Challenges, Part A: Thermal, Hydro and Nuclear Power , CRC Press, 06-Jul-2018.
2. Kenneth D. Kok, Nuclear Engineering Handbook, Second Edition , CRC Press, 03-Oct-2016

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Applicable for 2017-2021

Subject Code	ME366	Subject Title	Product Design And Development						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

Course Objective: This course aims at introducing the students to the basic concepts of engineering design and product development with focus on the front end processes. At the end of this course the student is expected to demonstrate an understanding of the overview of all the product development processes and knowledge of concept generation and selection tools.

Course Pre/Co- requisite (if any): Manufacturing Process, Industrial Engineering and Management

Detailed Syllabus

UNIT 1:

Significance of product design, Need for developing products, product design and development process, the importance of engineering design, sequential engineering design method, relevance of product lifecycle issues in design, the challenges of product development.

Product Planning and Project Selection: generic product development process, Identifying opportunities, evaluate and prioritize projects, allocation of resources, various phases of product development-planning for products.

UNIT 2:

Identifying Customer Needs voice of customer, customer populations, Interpret raw data in terms of customers need, hierarchy of human needs, need gathering methods, establish the relative importance of needs.

Product Specifications: Establish target specifications, setting final specifications

Concept Generation: Activities of concept generation, clarifying problem, search both internally and externally, explore the output

UNIT 3:

Industrial Design: Assessing need for industrial design, industrial design process, management, assessing quality of industrial design, human factors design, user friendly design

Concept Selection: Overview, concept screening and concept scoring, methods of selection, case studies.

UNIT 4:

Theory of inventive problem solving (TRIZ): Fundamentals, methods and techniques, General Theory of Innovation and TRIZ, Value engineering Applications in Product development and design, Model based technology for generating innovative ideas measurement of customers response.

Concept Testing: Elements of testing: qualitative and quantitative methods including survey.

UNIT 5:

Intellectual Property: Elements and outline, patenting procedures, claim procedure.

Design for Environment: Impact, regulations from government, ISO system, case studies.

Learning Outcome

At the end of the course the student can:

CO1:Product Design and Innovation course is intended to introduce overall awareness of the product design process.

CO2:This course will give an understanding of methods, tools and techniques applied in product design.

CO3:This course includes overview of innovation, product design process, user study, need/problem identification, development of design brief, understanding competitive benchmarking, aspects of human factors in product design, tools for creative concept generation, and prototyping/model making and evaluation techniques for user-product interaction.

CO4:This course will be explained with lectures including case studies and hands-on exercises. This will help students to generate creative ideas in to product design, considering human factors aspects.

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Text book [TB]:

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development”, Tata McGraw-Hill Education, 4th Edition, 2009.
2. Kevin Otto, Kristin Wood, “Product Design”, Pearson Education, Indian Reprint 2004.

REFERENCES [RB]:

1. Yousef Haik, T. M. M. Shahin, “Engineering Design Process Cengage Learning, 2010”, 2nd Edition Reprint.
2. Kevin Otto, Kristin Wood, “Product Design”, Pearson Education Indian Reprint 2004.
3. Clive L.Dym, Patrick Little, “Engineering Design: A Project-based Introduction”, John Wiley & Sons, 3rd Edition 2009.

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Applicable for 2017-2021

Subject Code	ME361	Subject Title	Industrial Robotics						
LTP	2 0 2	Credit	3	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

Course Objective: The Industrial Robotic subject equips graduates with the basic understanding of robotics automation, necessary skills to program, design automated production systems required for high-tech manufacturing industries.

Course Pre/Co- requisite (if any): Mechatronics

Detailed Syllabus

UNIT 1: Fundamentals of Industrial Robot

Automation, Definition, Robot anatomy, Co-ordinate systems, work envelope, types and classification, Specifications of robot, Pitch, yaw, roll, joint notations, speed of motion and pay load, Robot parts and their functions, Different applications.

UNIT 2: Robot Drives And Actuators

Pneumatic drives, Hydraulic drives, Mechanical drives, Electrical drives, D.C. servo motors, stepper motor and A.C. servo motors. Salient features, applications and comparison of all these drives, piezoelectric actuators.

UNIT 3: End Effectors And Sensors

End effectors: Mechanical grippers, pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers, RCC grippers, Two fingered and three fingered grippers, Internal grippers and external grippers, Selection and design considerations.

Sensors: Requirements of a sensor, principles and applications of the following types of sensors, Position of sensors (Piezo electric sensor, LVDT, Resolvers, Optical encoders, Pneumatic position sensors), Range sensors, Proximity sensors, Touch sensors, Slip Sensors.

UNIT 4: Robot Motion Analysis And Control

Introduction to manipulator kinematics, Homogeneous transformation and robot kinematics, Forward kinematics, Inverse kinematics, DH algorithm, Manipulator path control, overview of Robot dynamics.

UNIT 5: Robot Programming And Work Cell Design

Robot Programming- Introduction, robot programming technique, on line programming, lead through programming, Walk through programming, off-line programming, overview of robot programming languages.

Robot work cell- Robot cell layouts, Multiple robot and machine interference, work cell control, interlocks, error detection and recovery.

Learning Outcome

At the end of the course the student can:

CO1: Understand about fundamental of automation with industrial Robots.

CO2: Hardware understanding for any automated application and utilization in industry.

CO3: Selection of industrial robotics for an application and Programmed various application to design work cell.

CO4: Should able to design and developed industrial robot for any industrial application.

Text book [TB]:

1. Industrial Robotics, Technology programming and application by Mikell P. Groover , TMH publications.2010
2. Robotics technology and flexible automation by S.R.Deb , Mc Graw Hill publication.2006
3. Industrial automation and robotics by A.K.Gupta , University science press.2012

Reference books [RB]:

1. Robotics engineering, an integrated approach by Richard D klafter PHI publication.2006

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

2. A Textbook of Industrial Robotics by By Ganesh S. Hegde, Lakshmi publications.2012
3. Industrial Robotics, analysis, systems, applications by Saeed B Niku, Pearson publication.2010

List of Experiments:

1. Study of anatomy of industrial robotics.
2. Demonstration of robot with 2 DOF, 3 DOF, 4 DOF etc.
3. Programming the robot for pick up and place applications.
4. Robot programming by teach pendent
5. Programming the robot for applications in VAL –II.
6. Simulation of robot programming on software.
7. Design of robot work cell and simulation in software robot studios.
8. Two case studies of application.

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Applicable for 2017-2021

Subject Code	ME367	Subject Title	Plant Layout And Material Handling						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	3 rd	Semester	VI

Course Outline:

Course Objective Introduce student to designing of plant layout and material handling system so that they can design layout and material handling system in such a way that production can be carried out smoothly at minimum total cost.

Course Pre/Co- requisite (if any): Manufacturing Process, Industrial Engineering and Management

Detailed Syllabus

UNIT 1: PLANT LOCATION AND FACILITIES

Factors to be considered –influence of location on plant layout, selection of plant site, Consideration in facilities planning and layout. Equipment's required for plant operation, Capacity, serviceability and flexibility and analysis in selection of equipment, space requirements, and man power requirements.

UNIT 2: PLANT LAYOUT

Need for layout, types of layout, factors influencing product, process. Fixed and combination layout: tools and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models – machine data. Layout planning procedure. Visualization of layout, revision and improving existing layout, balancing of fabrication and assembly lines.

UNIT 3: MATERIAL HANDLING

Importance and scope. Principles of material handling. Planning, operating and costing Principles, types of material handling systems, factors influencing their choice.

UNIT 4: INDUSTRIAL BUILDING AND UTILITIES

Centralized electrical, pneumatic water line systems. Types of buildings, lighting, heating, air conditioning and ventilation utilities-planning and maintenance, waste handling, statutory requirements. Packing and storage materials: Importance of Packaging, layout for Packaging–Packaging machinery –wrapping and Packing materials, cushion materials.

UNIT 5: ANALYSIS OF MATERIAL HANDLING

Motion analysis, flow analysis, graphic analysis, safety analysis, equipment cost analysis, palletization analysis, analysis of operation, material handling surveys.

Learning Outcome

At the end of the course the student can:

CO1: Take the decision on selection of site and equipment's, space and manpower requirement.

CO2: Design the plant layout and material handling system.

CO3: Design the industrial building and planning and maintenance of various utilities.

Text book [TB]:

1. S. C. Sharma, Plant layout and material handling, Khanna publishers.2006
2. Agarwal, Plant layout and material handling, Jain brothers publication.2010

REFERENCES [RB]:

1. Shubin J A, Plant layout, P H I publications.1965
2. Oberman. Ya, Material handling, Mir publishers.1980
3. S.C. Sharma, Material Management And Material Handling, Khanna Publishers.1995

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Applicable for 2017-2021

Subject Code	HS304	Subject Title	Aptitude and Soft Skills IV						
LTP	3 0 0	Credit	0	Subject Category	AC	Year	III	Semester	VI

Course Outline: Aptitude and Soft Skills IV is the final step of programme and the module is designed to enhance the analytical and interpersonal skills of students to make them ready to face various placements, interviews. It will also help them learn various personality development techniques by enhancing their GD and PI skills. Mock Placement Drive will test and improve students by Feedback Sharing & Error Correction.

Course Objective:

1. Align themselves with the placement requirements and their needs
2. Learn analytical and employability skills
3. Prepare students for job placements so that they could clear the selection process successfully and give them strategies and skills to crack GD as well as PI to get selected with decent job offers

Course Pre/Co-requisite (if any):

1. Understanding grammar, number system and basic arithmetic, analytical reasoning concepts, covered in Aptitude and Soft Skills III
2. Professional profile building and Self introduction

Detailed Syllabus

UNIT 1: QUANTITATIVE APTITUDE	11 HOURS
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Partnership **02 hours**

Introduction & types; Speed, Distance and Time: Average Velocity; Race tracks - Straight and Circular; Trains; Boats and Streams.

Time and Work **02 hours**

Basic concepts (relationship between men, days and work); Understanding group efficiency; Alternate work; Negative work; Wages; Pipes and Cisterns.

Permutation and Combination **02 hours** Basic Principles of Counting (Addition and Multiplication); Arrangements around- Circular, Square and Rectangular tables and in straight lines, circular permutation, selection, distribution.

Probability **02 hours**

Introduction, various types of events; Classical definition of probability; Random and Discrete variables; Bayes' Theorem and question types.

Data Interpretation **03 hours**

Introduction; Different ways of representing data- Narration based, pictorial, pie chart, Bar graph, line charts; various questions based upon them.

UNIT 2: VERBAL APTITUDE	09 HOURS
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Cloze test **02 hours**

Intricacies of cloze test, correct use of specific adjectives, concept of sentence improvement, writing concept, auxiliaries and modals.

Words **02 hours**

Concept of consistency, precision, concision in terms of reading and writing, advance word choice with respect to placement papers, SAP (Subject-Audience-Purpose) approach.

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Clauses

02 hours

Subordinate Clauses- The noun clause, the adjective clause, the adverb clause, Analysis of simple and complex sentences, prepositional phrases, transformation of sentences.

Vocabulary

01 hour

Revisiting vocabulary- high, medium and low frequency words, organization of ideas and thoughts in order to understand the text- The Pyramid Principle.

Questions

02 hours

Various test taking skills in accordance with the placement papers.

UNIT 3: LOGICAL REASONING	11 HOURS
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Deductive Logic

03 hours

Premises and conclusion structure, Quality of deductive argument, Categorical arguments, Syllogism, Conditional Arguments- If..then, only if..then, If and only if, Either or.

Puzzles

02 hours

Grouping and selection, Double line up, Binary logic- truth teller-lie teller, Team formation and miscellaneous puzzles.

Set Theory and Critical Reasoning-II

03hours Union and Intersection of sets,

Use of venn diagrams in problem solving with two, three, four set, concept of maxima-minima through Venn diagram.

Critical reasoning II: Statement and Inference, cause and Effects, Statement and Arguments- Strengthen or Weaken the argument, Statement Assertion and Reason.

Non-Verbal Reasoning

01 hour

Mirror-image, Water-image, Spotting out the embedded figures, Completion of incomplete pattern, Figure matrix, Paper folding, Paper cutting, Grouping of identical figures, Counting figures, Non verbal series / analogies / odd man out.

Data Sufficiency

02 hours

Data Sufficiency based on logical reasoning field like Coding-Decoding / Puzzle Test / Blood Relations / Mathematical calculations / clock / calendar / etc.

UNIT 4: SOFT SKILLS	08 HOURS
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Group Discussion

04 hours

Importance, Do's & Don'ts, Personality Traits, Tips and Strategies, Types of Group Discussions.

Suggested Exercises, Games & Activities: Mock Group Discussions (on basic topics), with feedback sharing and error analysis.

Personal Interview

04 hours

Importance, Do's & Don'ts, Personality Interview, Tips and Strategies, Etiquette Rules.

Suggested Exercises, Games & Activities: Mock Personal Interviews (contd.) with feedback sharing and error analysis.

Learning Outcomes:

By the end of this semester, students will:

1. Be prepared for the upcoming placements and they will also be ready for other competitive exams.

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2. Improve their GD and PI Skills and be able to have firsthand experience of a Placement drive and gain sufficient confidence to perform well.

Text book [TB]:

1. Quantitative Aptitude : How to prepare for Quantitative Aptitude, Arun Sharma, McGraw Hill, 8th edition, 2018.
2. Logical Reasoning: A Modern Approach to Logical Reasoning-R.S. Aggarwal, S Chand Publishing; 2nd Colour edition-2018.
3. Verbal Aptitude : English is Easy- Chetanand Singh, BSC Publication-2018.
4. Soft Skills : Group Discussion on Current Topics by P. N. Joshi; Upkar Prakashan-2010.

Reference books [RB]:

1. Quantitative Aptitude:Quantitative Aptitude for Competitive Examinations- R.S. Agarwal, S. Chand Publications-2017.

Quantitative Aptitude:Quantitative Aptitude-Saurabh Rawat & Anushree Sah Rawat Savera Publishing House, 1st edition-2016.

2. Logical Reasoning: Logical Reasoning and Data Interpretation for the CAT - Nishit K Sinha, Pearson India; 5th edition-2016.
Logical Reasoning: Wiley's Verbal Ability and Reasoning - P A ANAND, Wiley-2016.
3. Verbal Aptitude: Oxford Guide to English Grammar- John Eastwood, Oxford University Press-2003.
Verbal Aptitude: Fun with grammar- Suzanne W. Woodward Pearson Education ESL-1996.
4. Soft Skills: AComplete Kit for Group Discussion by S. Hundiwala; Arihant publications; edition-2018.
Soft Skills: Basic Interviewing Skills by Raymond L. Gorden, Waveland Press, Inc.; 1 edition-1998.

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Applicable for 2017-2021

Subject Code	ME458	Subject Title	Automotive Refrigeration and Air Conditioning						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: To make the students understand the fundamentals of refrigeration systems. Familiarize the students with concept of psychometry and its application in air conditioning systems.

Course Pre/Co- requisite (if any): Basic Thermodynamics and Heat transfer

Detailed Syllabus

UNIT 1: Refrigeration

Introduction - Methods of refrigeration - Air Refrigeration System and its applications – Vapour compression refrigeration system - Vapour absorption refrigeration system - Applications of refrigeration & air conditioning - Automobile air conditioning -Air conditioning for passengers, isolated vehicles, transport vehicles-Applications related with very low temperatures.

Classification, properties and selection criteria - Commonly used refrigerants – Alternative refrigerants - Eco-friendly refrigerants - Applications of refrigerants -Refrigerants used in automobile air conditioning.

UNIT 2: Psychometry

Psychometric properties, tables, charts - Psychometric processes - Comfort charts – Factor affecting comfort - Effective temperature - Ventilation requirements

UNIT 3:Air Conditioning Systems and Load Analysis

Classification and layouts - Central / unitary air conditioning systems - Components like compressors, evaporators, condensers, expansion devices, fan blowers, heating systems etc. Load Analysis: Outside & inside design consideration - Factors forming the load on refrigeration & air conditioning systems - Cooling & heating load calculations - Load calculations for automobiles - Effect of air conditioning load on engine performance

UNIT 4:Air Distribution Systems

Distribution duct system, sizing, supply / return ducts - Types of grills, diffusers, ventilation, air noise level - Layout of duct systems for automobiles and their impact on load calculations. Air Routine & Temperature Control: Objectives - evaporator care air flow - Through the dash re-circulating unit - Automatic temperature control - Controlling flow - Control of air handling systems.

UNIT 5:Air Conditioning Service and Control

Air conditioner maintenance & service - servicing heater system - Removing & replacing components - Trouble shooting of air conditioning system -Compressor service, methods of dehydration, charging & testing.

Air Conditioning Control: Common control such as thermostats- Humidistat us – Control dampers - Pressure cutouts and relays

Learning Outcome

At the end of the course the student can:

CO1: Design and implement refrigeration and air conditioning systems using standards.

CO2: Apply the concept of psychometry to estimate the heating and cooling load for automobiles.

CO3: Check the operation of automatic heating, ventilation and air conditioning (HVAC) control systems and diagnose it.

Text book [TB]:

1. Mark Schnubel, “Automotive Heating and Air Conditioning”, Today’s Technician, 5th edn,
2. Norman C. Harris, “Modern Air-Conditioning Practice”, McGraw-Hill Education 1984

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Reference Books [RB]:

1. Steven Daly, "Automotive Air Conditioning and Climate Control Systems", Butterworth-Heinemann; 1st edition (2006).
2. R.J. Dossat, "Principles of Refrigeration", Prentice Hall, 5th ed, 2001.
3. Paul Lung, "Automotive Air Conditioning", C.B.S. Publisher & Distributor, (Delhi. 1991)
4. W.F. Stoecker and J.W. Jones, "Refrigeration and Air-Conditioning", Tata McGraw Hill Pub, 1982

Course Structure of B.Tech. – Mechanical Engineering

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Applicable for 2017-2021

Subject Code	ME442	Subject Title	Gas Turbine And Jet Propulsion						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: To understand the features of compressible isentropic flows and irreversibilities like shocks

Course Pre/Co- requisite (if any): Applied Thermodynamics I, Power Plant Engineering

Detailed Syllabus

UNIT 1:

Review of Thermodynamic principles, Gas turbine cycles, main components of Gas turbine power plants, performance characteristics, typical Gas Turbine Plants. Methods of improving efficiency and power output of gas turbine plants.

UNIT 2:

Types of Gas turbine plants and their theory of operation, design consideration of gas turbine plants. Detailed study of main systems of gas turbine plants. Selection of materials of Gas turbine components. Trouble shooting, maintenance and actual performance evaluation of gas turbine plants. Recent development of gas turbine plants

UNIT 3:

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

UNIT 4:

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

Learning Outcome

At the end of the course the student can:

CO1: Have a basic knowledge of jet and rocket propulsion technologies.

CO2: Apply gas dynamics principles to jet and space propulsion systems.

CO3: Understanding of various methods of turbines and propulsion system.

Text book [TB]:

1. "Gas Turbine Fundamentals", Cohen, Rogers and Saravanamutto, Pearson Education 2010
1. Ahmed F. El-Sayed, Aircraft Propulsion and Gas Turbine Engines, CRC Press, 2008.

REFERENCES [RB]:

1. Gas Turbines", V. Ganeshan, Tata-McGraw-Hill, New Delhi.2006
2. Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley, 1992.
3. "Jet Propulsion", Jack D. Mattingly, McGraw Hill Inc 2006
4. Sutton G.P., Rocket Propulsion Elements, John Wiley, New York, 1986.

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Applicable for 2017-2021

Subject Code	ME443	Subject Title	Design of Transmission System						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: To learn about the design procedures for mechanical power transmission components

Course Pre/Co- requisite (if any): Design of Machine Elements

Detailed Syllabus

UNIT 1:

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

UNIT 2:

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.

UNIT 3:

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.

UNIT 4:

Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-speed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications.

UNIT 5:

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.

Learning Outcome

CO1: Design transmission systems for engines and machines..

CO2: Students will learn about gear box design and selection process.

CO3: students will able to design cam design and selection process of any application.

Text book [TB]:

1. Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010.
2. Yi Zhang, Chris Mi, Automotive Power Transmission Systems, John Wiley & Sons, 31-Aug-2018

REFERENCES [RB]:

1. Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.
2. Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001.

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME444	Subject Title	Avionics						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: To understand the basic of avionics and its need for civil and military aircrafts.

Course Pre/Co- requisite (if any): Fluid Mechanics

Detailed Syllabus

UNIT 1: Introduction to Avionics

Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies – Introduction to digital computer and memories

UNIT 2: Digital Avionics Architecture

Avionics system architecture – data buses – MIL-STD-1553B – ARINC – 420 – ARINC – 629.

UNIT 3: Flight Decks and Cockpits

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS

UNIT 4: Introduction to Navigation Systems

Radio navigation – ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS, MLS – Inertial Navigation Systems (INS) – Inertial sensors, INS block diagram – Satellite navigation systems – GPS.

UNIT 5: Air Data Systems and Auto Pilot

Air data quantities – Altitude, Air speed, Vertical speed, Mach number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

Learning Outcome

At the end of the course the student can:

CO1: Understand and develop the avionic architecture and various avionics data buses

CO2: Develop various avionics subsystems

CO3: Student will learn about air data and navigation system .

Text book [TB]:

1. Albert Helfrick.D., "Principles of Avionics", Avionics Communications Inc., 2004
3. Collinson.R.P.G. "Introduction to Avionics", Chapman and Hall, 1996

REFERENCES [RB]:

1. Middleton, D.H., Ed., "Avionics systems, Longman Scientific and Technical", Longman Group UK Ltd., England, 1989.
2. Spitzer, C.R. "Digital Avionics Systems", Prentice-Hall, Englewood Cliffs, N.J., U.S.A. 1993.
3. Spitzer. C.R. "The Avionics Hand Book", CRC Press, 2000
4. Pallet.E.H.J., "Aircraft Instruments and Integrated Systems", Longman Scientific

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Applicable for 2017-2021

Subject Code	ME445	Subject Title	Total Quality Management						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: To facilitate the understanding of total quality management principles and processes.

Course Pre/Co- requisite (if any): Manufacturing Process, Industrial Engineering and Management

Detailed Syllabus

UNIT 1:

Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

UNIT 2:

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

UNIT 3:

The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.

UNIT 4:

TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.

UNIT 5:

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

Learning Outcome

At the end of the course the student can:

CO1: To facilitate the understanding of total quality management principles and processes.

CO2: Student will learn about ISO systems

CO3: Student will learn about various quality tools to improve products quality.

Text book [TB]:

1. Besterfield D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
5. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
6. Subburaj Ramasamy, McGraw-Hill Education, 2012 - Total quality management.

REFERENCES [RB]:

1. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
2. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME446	Subject Title	Design of Hydraulics & Pneumatics System						
LTP	2 0 2	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: The subject gives in-depth knowledge of different system working on fluid power and compressed air with understanding of different valves used in the hydraulic and pneumatic system.

Course Pre/Co- requisite (if any): Fluid Mechanics and Fluid Machines

Detailed Syllabus

UNIT 1: Introduction

Mechanization vs. Automation, low cost automation with hydraulics and pneumatics. Requirement of industrial automation with hydraulics and pneumatics.

Basic pneumatics and hydraulics system: Fundamentals and basic principal of Hydraulics, advantages and disadvantages, pneumatics power vs. hydraulics power, overview of basic pneumatics and basic hydraulic systems.

UNIT 2: Hydraulic and pneumatic Actuators

Pumps and compressors: Pumps vs. compressor, classification of pumps, positive displacement pumps, rotary pumps, and reciprocating pumps, centrifugal pumps. Pump selection parameters. Types of air compressors, positive displacement compressor, rotary compressor, reciprocating compressor.

Cylinders and motors: Symbolic representation of motors and cylinders, cylinder classification on the basis of construction, single acting cylinder, double acting cylinder, other types of cylinders. Hydraulic and pneumatics cylinders, cylinder sizing, types of motors, motor rating, gear motors and vane motors

UNIT 3: Fluid Accessories and control valves

Fluid Accessories: Air receiver, air dryer, air filter, Pressure regulator, Air service unit (FRL), Seals, hydraulic filters, accumulator, intensifier, Hoses, pressure gauge.

Control Valves: Direction control valves, Pressure control valves, Flow control valves, Non-return valves, Reservoirs, Sequence valve, pneumatic logic valve, shuttle and servo valves, Selection of valves for circuits, Symbolic representation of control valves and fluid accessories.

UNIT 4: Design of pneumatic circuits

Pneumatics circuits for control of single acting cylinder and double acting cylinder. Circuit with mechanical feedback, speed control circuit, use of flow control valve, quick exhaust valve in pneumatics circuits. Application with twin pressure and shuttle valves. Sequencing and cascading method for two and three cylinder application.

UNIT 5: Design of hydraulic circuits

Hydraulic circuits for control of single acting cylinder and double acting cylinder. Circuit with mechanical feedback, speed control circuit, use of flow control valve, quick exhaust valve in hydraulic circuits. Application with twin pressure and shuttle valves. Designing of Sequencing and cascading circuit for two and three cylinder application.

Learning Outcome

At the end of the course the student can:

CO1: Identify and analyse operation of industrial fluid power and pneumatics systems, including the design, application, and trouble-shooting.

CO2: Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro-pneumatics for a given application. Develop a circuit diagram.

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CO3: Identify different symbols of components used in hydraulic and pneumatic system.

CO4: Selection and sizing of components of the circuit.

Text book [TB]:

1. Industrial Hydraulics by John Pippenger and Tyler Hicks, McGraw Hill.
2. Oil Hydraulic Systems, Principle and Maintenance by S R Majumdar, McGraw-Hill.
3. Fluid Power with Applications by Anthony Esposito, Pearson.
4. Industrial automation and robotics by A.K.Gupta , University science press.

Reference books [RB]:

1. Fluid Power: Generation, Transmission and Control, Jagadeesha T., Thammaiah Gowda, Wiley.
2. The Analysis & Design of Pneumatic Systems by B. W. Anderson, John Wiley.
3. Control of Fluid Power Analysis and Design by Mc Clay Donaldson, Ellis Horwood Ltd.
4. Hydraulic and Pneumatic Controls: Understanding made Easy, K.Shanmuga Sundaram, S.Chand & Co Book publishers, New Delhi, 2006 (Reprint 2009)
5. Basic Pneumatic Systems, Principle and Maintenance by S R Majumdar, McGraw-Hill.
6. Basic fluid power Dudley, A. Pease and John J. Pippenger, , Prentice Hall, 1987

List of Experiments:

- A. Experiments on Hydraulics Circuits:
 1. Extend-Retract and Stop system of a linear actuator.
 2. Regenerative circuit.
 3. Speed Control circuits: meter-in, meter-out and bleed off.
 4. Sequencing circuit
 5. Use of solenoid operated DCV.
 6. Rapid Traverse and Feed circuit.
- B. Experiments on Pneumatic Circuits:
 1. Study of Compressor, FRL unit and 5/3 DCV.
 2. Reciprocating motion of a single and a double-acting actuator using 5/3 DCV.
 3. Speed control circuits.
 4. Automatic to & fro motion of a pneumatic linear actuator.
 5. Sequencing circuit.
 6. Logical circuits using shuttle valve.
 7. Cascading Circuit

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Applicable for 2017-2021

Subject Code	ME459	Subject Title	Special Vehicles & Equipment's						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: To provide the basic knowledge about the constructional and working of Tractors, Earth Moving Machines, Special Vehicles & Equipments.

Course Pre/Co- requisite (if any): Advanced Automobile Engineering

Detailed Syllabus

UNIT 1: Tractors

Development of tractors – prominent makes in India – Classification of tractors – main components-safety rules – Engine frame work – cooling system lubrication system – Fuel system – Salient features of tractor chassis, clutch, power transmission, final drive, steering, brakes & wheels.

UNIT 2: Farm Equipment

Tractor controls – Power take off, draw bar working – working of hydraulic system Working attachment of tractors, 3-Point Linkage – farm equipment- classification – auxiliary equipment - trailers & body tipping mechanism.

UNIT 3:Off Road & Land Clearing Vehicles

Classification & requirement – Power plants – chassis – transmission – multi axle vehicles. Land Clearing Machines Bush cutter, stumpers, Tree dozer, Rippers.

UNIT 4:Earth Moving Machines

Bulldozers, cable and hydraulic dozers. Crawler track, running and steering gears, scrapers, drag and sell powered types–Dump tracks and dumpers – Loaders, single bucket, multi bucket and rotary types- Power and capacity of earth moving machines. Scrapers, elevating graders, self-powered scrapers and grader

Learning Outcome

At the end of the course the student can:

CO1: Design and implement refrigeration and air conditioning systems using standards.

CO2: Apply the concept of psychometry to estimate the heating and cooling load for automobiles.

CO3: Check the operation of automatic heating, ventilation and air conditioning (HVAC) control systems and diagnose it.

Text book [TB]:

1. Road making Machinery by Abrosimov. K. Bran berg. A and Katayer. K., MIR Publishers, 1971.
2. Theory of Ground vehicles by Wang. J.T., John Wiley & Sons, New York, 1987.
3. Off the road Wheeled and combined traction devices Ashgate Publishing Co. Ltd. 1988

Reference Books [RB]:

1. Tractor and Automobiles by Rodichev and G. Rodicheva, MIR Publishers, 1987.
2. Design of Automotive engines for tractor by Kolchin A and V. Demidov, MIR Publishers, 1972

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME449	Subject Title	Micro & Nano Machining						
LTP	2 0 2	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: To enable the students, understand the basic principles and mechanism of Traditional and Advanced Micro Nano machining and its applications, fundamentals of MEMS and its techniques

Course Pre/Co- requisite (if any): Manufacturing Processes

Detailed Syllabus

UNIT 1: Introduction to Micro Nano Machining

Need-evolution- fundamentals and trends in micro and nano technologies-Consequences of the technology and society-challenges to manufacturing technology-evolution of precision in manufacturing, tooling and current scenario- Micro Nano materials, fabrication tools, requirements and applications.

UNIT 2: Traditional Micro Nano machining

Theory of micromachining – Chip formation – Size effect in micromachining – micro-turning micro milling, Micro drilling - Micromachining tool design – Precision Grinding – Partial ductile mode grinding – Ultraprecision grinding.

UNIT 3: Advanced Micro Nano machining

Introduction-Classification- Mechanical Micromachining (AJM, USM)- Thermal Micromachining (EDM, LBM, EBM)-Electrochemical and Chemical Micromachining, Ion Beam Machining, Photochemical Etching.

UNIT 4: Abrasive based Micro Nano machining

Abrasive Flow Finishing (AFF), Magnetic Abrasive Finishing (MAF), Magnetorheological Finishing, Magnetorheological Abrasive Flow Finishing, Elastic Emission Machining (EEM) and Magnetic Float Polishing

UNIT 5: MEMS

Introduction to MEMS, Definitions and classifications-History-applications-MEMS Market- Bulk Micromachining- Wet and Dry Etching-Surface Micromachining-Chemical-Vapor Deposition-Lithography-Wafer Bonding.

Learning Outcome

At the end of the course the student can:

- CO1: Understand the basic need of Micro Nano Machining in different industries.
- CO2: Demonstrate and understand the Traditional Micro Nano machining techniques.
- CO3: Demonstrate and Understand different mechanisms in Advanced Micro Nano machining.
- CO4: Understand the importance of Abrasives in Micro Nano Machining.
- CO5: Understand the need of MEMS in Micro Nano Machining.

Text book [TB]:

1. V.K.Jain, Introduction to Micromachining, Narosa publishing House, New Delhi.2010
2. V. K. Jain (2012), Micromanufacturing Processes, CRC Press

Reference books [RB]:

1. J. Paulo Davim, Mark J. Jackson (2009) Nano and Micromachining, John Wiley & Sons
2. Mohamed Gad-el-Hak (2010) MEMS Introduction and Fundamentals, CRC Press

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Applicable for 2017-2021

Subject Code	ME451	Subject Title	Finite Element Analysis						
LTP	2 0 2	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: To enable the students, understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics, heat transfer and fluid flow problems.

Course Pre/Co- requisite (if any): Strength of materials, Engineering Mathematics

Detailed Syllabus

UNIT 1: Introduction to Finite Element Method

General description of Finite Element Method – Historical development – Comparison with classical methods – General procedure of FEM - Applications of FEM – FEA softwares. General field problems, discrete and continuous models, Variational formulation in finite elements – Ritz method - Weighted residual methods – Galerkin – sub domain – method of least squares and collocation method - numerical problems.

UNIT 2: Discretization and Interpolation Function

Discretization: Geometrical approximations – Simplification through symmetry – Element shapes and behaviour – Choice of element types – size and number of elements – Element shape and distortion – Location of nodes – Node and Element numbering.

Interpolation Function: Simplex - Complex and Multiplex elements – Selection of interpolation polynomials - Convergence requirements – Natural coordinate systems - Derivation of shape functions for various elements – Isoparametric elements – Numerical Integration.

UNIT 3: Applications in structural

One dimensional elasticity – Castigliano's first theorem – Principle of minimum potential energy - Linear spring - Elastic bar with constant and varying cross sections using linear and quadratic elements – Truss structures and Beams.

UNIT 4: Applications in plane elasticity

Introduction to plane elasticity theory – Plane stress, Plane strain and Axisymmetric problems – Finite Element formulations of plane elasticity problems using CST and four noded quadrilateral elements only.

UNIT 5: Applications in Heat Transfer and Fluid Mechanics

Finite Element formulation of One-dimensional and Two-dimensional steady state heat conduction problems with convection - Simplex elements only.

Finite Element formulation of inviscid and incompressible flow – Potential function formulation – Stream function formulation.

Learning Outcome

At the end of the course the student can:

CO1: Apply the knowledge of Mathematics and Engineering to solve problems in structural, heat transfer and fluid flow by FEM

CO2: Use commercial FEA packages like ANSYS and modern CAD/CAE tools for solving real life problems

CO3: Derive finite element equations for simple and complex elements

Text book [TB]:

1. Tirupathi R. Chandrupatla and Ashok D. Belugundu, (2011), Introduction to Finite Elements in Engineering, Prentice Hall.
2. David V Hutton, (2009), Fundamentals of Finite Element Analysis, Tata McGraw-Hill Education.

Reference books [RB]:

1. Daryl L. Logan, (2011) A First Course in the Finite Element Method, Cengage Learning.
2. Bathe Klaus-Jürgen, (2009), Finite element procedures, PHI Learning.
3. Rao S. S., (2011), The Finite Element Method in Engineering, Elsevier.
4. Zienkiewicz O.C., Taylor R.L., Zhu J.Z. (2011), The Finite Element Method: Its basis and fundamentals, Butterworth Heinmann.

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5. Madenci Erdogan, Guven Ibrahim (2011), Finite Element Method and Applications In Engineering using ANSYS, Springer.

List of Experiments:

1. Introduction to ANSYS: 6 hrs.
2. Analysis of spring systems
3. One-Dimensional elasticity problems
4. Plane truss analysis
5. Beam analysis
6. 2-D frame analysis
7. Plane stress analysis using CST element
8. One-dimensional heat conduction considering convection

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME460	Subject Title	Vehicle Body Engineering						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: To provide the basic knowledge about construction techniques & various types of automotive bodies under the light of aerodynamics.

Course Pre/Co- requisite (if any): Advanced Automobile Engineering

Detailed Syllabus

UNIT 1:

Car Body Details:

Types: Saloon, Convertibles, Limousine, Estate van, racing and sports car.

Visibility: Regulations, driver's visibility, test for visibility, Methods of improving visibility and space in cars.

Safety: Safety design, safety equipments for car. Car body construction.

UNIT 2:

Vehicle Aerodynamics: Objectives, Vehicle drag and types, various types of forces and moments, Effects of forces and moments, side wind effects on forces and moments, various body optimization techniques for minimum drag.

Wind tunnel testing: Flow visualization techniques, scale model testing. Component balance to measure force and moments.

UNIT 3:

Bus Body Details: Types, minibus, single decker, double decker, two level, split level and articulated bus. Bus Body Lay Out: Floor height, engine location, entrance and exit location, seating dimensions

UNIT 4:

Constructional details: Frame construction, Double skin construction-Types of metal section used-Regulations-Conventional and Integral type construction.

UNIT 5:

Commercial Vehicle Details: Types of body, Flat platform, drop side, fixed side, tipper body, tanker body. Light commercial vehicle body types, Dimensions of driver's seating relation to controls, driver's cabin design. Body Materials, Trim and Mechanisms: Steel sheet, timber, plastics, GRP, properties of materials-Corrosion anti-corrosion methods, scalation of paint and painting process, body trim items. Body mechanisms.

Learning Outcome

At the end of the course the student can:

CO1: Be exposed the fundamentals in various automotive body construction techniques

CO2: Integrate the concepts of aerodynamics in body engineering for better style and low drag.

CO3: familiarizes the various types of bus body construction, seating layout, regulations and comfort.

CO4: Understands the various heavy vehicle bodies, driver's visibility and cabin design

Text book [TB]:

1. Powloski. J. Vehicle Body Engineering, Business Books Ltd., 1989.
2. Giles. J. C. Body construction and design, Illiffe Books Butterworth & Co., 1971

Reference Books [RB]:

1. John Fenton, Vehicle Body layout and analysis, Mechanical Engg. Publication Ltd., London, 1982
2. Braithwaite. J. B, Vehicle Body building and drawing, Heinemann Educational Books Ltd., London, 1977.

Course Structure of B.Tech. – Mechanical Engineering

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Applicable for 2017-2021

Subject Code	ME447	Subject Title	Mechanical Vibration						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective:

Course Pre/Co- requisite (if any): Theory of Machines

Detailed Syllabus

UNIT 1:

Periodic motion, harmonic motion, superposition of simple harmonic motions, beats, Fourier analysis. Single Degree Freedom System: Free vibration, Natural frequency, Newton's method, Rayleigh method and Energy method for determining natural frequency, Response to an initial disturbance, Torsional vibrations, Damped vibrations. Damping models – Structural, Coulomb and Viscous damping, Vibrations of system with viscous damping, Logarithmic decrement, Viscous dampers.

UNIT 2: Single Degree Freedom

Forced vibration, Sources of excitation, Harmonic Excitation with viscous damping, Steady state vibrations, forced vibrations with rotating and reciprocating unbalance, support excitation, Vibration Isolation and Transmissibility, Vibration measuring instruments- Displacement, Velocity, Acceleration and Frequency measuring instrument.

UNIT 3: Two Degree of Freedom System

Introduction, Principal modes, Double pendulum, Torsional system with damping, Coupled System, Vibration absorbers, Centrifugal pendulum absorber, Dry friction damper, Untuned viscous damper.

UNIT 4: Multi-degree of Freedom Systems

Exact Analysis, Undamped free and forced vibrations of multi degree system, Influence coefficients, Reciprocal Theorem, Torsional vibration of multi-rotor system, Principal coordinates, Numerical Analysis - Rayleigh's Method, Dunkerley's formula, Holzer's Method, Stodola's Methods and Rayleigh – Ritz method.

UNIT 5: Critical Speed of Shafts

Shafts with one disc with and without damping, Multi-disc shafts, Secondary Critical speed. Continuous systems- Longitudinal vibration of bars, Torsional vibrations of Circular Shafts, Lateral vibration of beams.

Learning Outcome

At the end of the course the student can:

Upon successful completion of this course you should be able to:

CO1: Develop mathematical model of dynamic systems with single degree of freedom,

CO2: Develop mathematical model of dynamic systems with multiple degrees of freedom,

CO3: Calculate natural frequency and period of simple vibrating mechanical systems,

CO4: Deal with engineering systems involving vibration isolation and rotating imbalance

Text book [TB]:

1. S.S. Rao, Mechanical Vibrations, 4th edition, Pearson, 2014
2. Magreb, Cengage, Mechanical Vibration, India, New Delhi 2012

Reference books [RB]:

1. Dr. Debabrata Nag, Mechanical Vibrations, 1st edition, 2011
2. V. P. Singh, Mechanical Vibrations, 3rd edition, Dhanpat Rai & Co., 2011.

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Applicable for 2017-2021

Subject Code	ME450	Subject Title	Automatic Control						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective:

Course Pre/Co- requisite (if any): Engineering Mathematics

Detailed Syllabus

UNIT 1:

Introduction to control system, types of control system, applications of control system, transfer function, block diagram analysis, signal flow graphs, introduction to differential equations, mathematical models of physical systems.

UNIT 2:

Introduction to Laplace transform, Laplace transform theorems, inverse Laplace transforms and theorems, application of the Laplace Transform to the Solution of Linear Ordinary Differential Equations.

UNIT 3:

Feedback characteristics of control systems, control systems and components; Time response analysis: Time Response of linear control systems, the Unit-Step Response and Time-Domain Specification, Steady-State Error, Time Response of a First-Order System, Transient Response of a Second-Order System.

UNIT 4:

Concepts of stability and algebraic criteria; Routh's stability criteria, Root locus technique; basic properties of Root Loci, properties of the Root Loci, Frequency response analysis, Bode plot and Nyquist stability criteria and Nyquist plot.

UNIT 5:

Stability in frequency domain; phase lag, phase lead, Introduction to controller design, PI, PD and PID controller. Introduction to state variable analysis.

Learning Outcome

CO1: An ability to apply knowledge of mathematics, science and engineering.

CO2: ability to perform laboratory work and report on its outcome.

CO3: An ability to use the analysis and design tools of classical linear control in simplified homework problems, and in more realistic laboratory problems.

CO4: Communication skills (personal and academic). To help the student develop critical thinking and Problem-solving. Practical and subject specific skills (Transferable Skills).

Text book [TB]:

1. Kuo, B., "Automatic Control Systems", John Willey and Sons, 8th edition, 2009.
2. Ogata, K., "Modern Control Engineering", Prentice Hall, 5th edition, 2010

Reference books [RB]:

1. U.A.Bakshi, V.U.Bakshi, Automatic Control System, Technical Publications, 2009.
2. Nagrath, I.J. and Gopal, M., 2006, Control system engineering, New Age International publishers.

Course Structure of B.Tech. – Mechanical Engineering

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Applicable for 2017-2021

Subject Code	ME461	Subject Title	Alternate Fuel & Energy						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: To make student understand & analyze Alternative Fuels for Engine.

Course Pre/Co- requisite (if any): Thermodynamics and heat Engines

Detailed Syllabus

UNIT 1: Introduction

Need for alternate fuel, availability and properties of alternate fuels, general use of alcohols, LPG, hydrogen, ammonia, CNG and LNG, vegetable oils and biogas, merits and demerits of various alternate fuels, introduction to alternate energy sources. Like EV, hybrid, fuel cell and solar cars.

UNIT 2: Alcohols

Properties as engine fuel, alcohols and gasoline blends, performance in SI engine, methanol and gasoline blends, combustion characteristics in CI engines, emission characteristics, DME, DEE properties performance analysis, performance in SI & CI Engines

UNIT 3: Natural Gas, LPG, Hydrogen And Biogas

Availability of CNG, properties, modification required to use in engines, performance and emission characteristics of CNG using LPG in SI & CI engines, performance and emission of LPG. Hydrogen; storage and handling, performance and safety aspects.

UNIT 4: Vegetable Oils

Various vegetable oils for engines, esterification, performance in engines, performance and emission characteristics, bio diesel and its characteristics

UNIT 5: Electric, Hybrid, Fuel Cell and Solar Cars

Layout of an electric vehicle, advantage and limitations, specifications, system components, electronic control system, high energy and power density batteries, hybrid vehicle, fuel cell vehicles, solar powered vehicles.

Learning Outcome

At the end of the course the student can:

CO1: Understand the various alternative fuels available.

CO2: Determine alternative fuels properties, performance characteristics, combustion characteristics, emission characteristics.

CO3: Determine Engine Modification required for alternative fuels.

CO4: Determine Electric, Hybrid and fuel cell technologies

Text book [TB]:

1. Richard.L.Bechfold – Alternative Fuels Guide Book - SAE International Warrendale- 1997.
2. Maheswar Dayal - "Energy today & tomorrow"- I & B Horishr India - 1982.
3. G.D. Rai "Non-conventional sources of energy Khanna Lab

Reference Books [RB]:

1. "Alcohols as motor fuels progress in technology" - Series No.19 - SAE PublicationUSE - 1980.
2. SAE paper nos. 840367, 841333, 841334, 841156, Transactions, SAE, USA.
3. William Hamilton 'Electric Automobiles', PHI 2010

Course Structure of B.Tech. – Mechanical Engineering

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Applicable for 2017-2021

Subject Code	ME462	Subject Title	Emerging Automotive Technologies						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: To provide the basic knowledge about the recent updates in the automotive technologies.

Course Pre/Co- requisite (if any): Advanced Automobile Engineering

Detailed Syllabus

UNIT 1: The Future of the Automotive Industry

Challenges and Concepts for the 21st century. Crucial issues facing the industry and approaches to meet these challenges.

Fuel Cell Technology for Vehicles: What is fuel cell, Type of fuel cell, Advantages of fuel cell. Current state of the technology. Potential and challenges. Advantages and disadvantages of hydrogen fuel.

UNIT 2: Latest Engine Technology Features

Advances in diesel engine technology. Direct fuel injection Gasoline engine. Diesel particulate emission control. Throttling by wire. Variable Valve Timing, Method used to effect variable Valve Timing. Electromagnetic Valves, Camless engine actuation

UNIT 3: Vehicles Systems

Constantly Variable Transmission, Benefits, Semi-active and fully-active suspension system. Advantages of fully active suspension system. Use of Automotive micro controllers. Types of sensors. Use of actuators in an automobile environment.

X-By Wire Technology: What is X-By Wire, Advantage over hydraulic systems. Brake by wire, advantages over power Braking System. Electrical assist steering, Steering by wire, Advantages of Steering by wire.

UNIT 4: 42 Volt System

Need, benefits, potentials and challenges. Technology Implications for the Automotive Industry. Technological evolution that will occur as a result of the adoption of 42-volt systems.

Integrated Starter Alternator: Start stop operation, Power Assist, Regenerative Braking. Advanced lead acid batteries, Alkaline batteries, Lithium batteries, Development of new energy storage systems, Deep discharge and rapid charging ultra-capacitors.

UNIT 5: Electrical And Hybrid Vehicles

Types of hybrid systems, Objective and Advantages of hybrid systems. Current status, Future developments and Prospects of Hybrid Vehicles

Learning Outcome

At the end of the course the student can:

CO1: Understand the various alternative fuels available.

CO2: Determine alternative fuels properties, performance characteristics, combustion characteristics, emission characteristics.

CO3: Determine Engine Modification required for alternative fuels.

CO4: Determine Electric, Hybrid and fuel cell technologies

Text book [TB]:

1. Advanced Vehicle Technologies by Heinz Heisler-SAE International Publication.2006

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2. Electric and Hybrid Electric vehicles by Ronald K. Jurgens- SAE International Publication 2010
3. Electronic Braking, Traction and Stability control-SAE Hardbound papers.2006

Reference Books [RB]:

1. Electronics steering and suspension systems- SAE Hardbound papers.
2. 42 Volt system by Daniel J. Holt- SAE International Publication
3. Diesel Particulate Emission by J.H. Johnson- SAE Hardbound papers.
4. Fuel Cell Technologies for vehicles by Richard Stobart- SAE Hardbound papers

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	CS481	Subject Title	Software Quality Engineering						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4 th	Semester	VII

UNIT-I: Introduction

(7 L)

Defining Software Quality, Software Quality Attributes and Specification, Cost of Quality, Defects, Faults, Failures, Defect Rate and Reliability, Defect Prevention, Reduction, and Containment, Overview of Different Types of Software Review, Introduction to Measurement and Inspection Process, Documents and Metrics.

UNIT-II: Software Quality Metrics

(8 L)

Product Quality Metrics: Defect Density, Customer Problems Metric, Customer Satisfaction Metrics, Function Points, In-Process Quality Metrics: Defect Arrival Pattern, Phase-Based Defect Removal Pattern, Defect Removal Effectiveness, Metrics for Software Maintenance: Backlog Management Index, Fix Response Time, Fix Quality, Software Quality Indicators.

UNIT-III: Software Quality Management and Models

(8 L)

Modeling Process, Software Reliability Models: The Rayleigh Model, Exponential Distribution and Software Reliability Growth Models, Software Reliability Allocation Models, Criteria for Model Evaluation, Software Quality Assessment Models: Hierarchical Model of Software Quality Assessment.

UNIT-IV: Software Quality Assurance

(8 L)

Quality Planning and Control, Quality Improvement Process, Evolution of Software Quality Assurance (SQA), Major SQA Activities, Major SQA Issues, Zero Defect Software, SQA Techniques, Statistical Quality Assurance, Total Quality Management, Quality Standards and Processes.

UNIT-V: Software Verification, Validation & Testing:

(8 L)

Verification and Validation, Evolutionary Nature of Verification and Validation, Impracticality of Testing all Data and Paths, Proof of Correctness, Software Testing, Functional, Structural and Error-Oriented Analysis & Testing, Static and Dynamic Testing Tools, Characteristics of Modern Testing Tools.

Text Book:

1. Jeff Tian, Software Quality Engineering (SQE), Wiley-Interscience, 2005; ISBN 0-471- 713457.
2. Stephen H. Kan, Metrics and Models in Software Quality Engineering, Addison-Wesley (2002), ISBN: 0201729156

Reference Book:

1. Stephen H. Kan, Metrics and Models in Software Quality Engineering, Addison-Wesley Professional
2. Taz Daughtrey, Fundamental Concepts for the Software Quality Engineer, ASQ Quality Press.

Course Structure of B.Tech. – Mechanical Engineering

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Applicable for 2017-2021

Subject Code	IT353	Subject Title	Basics of Data Science						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4 th	Semester	VII

Course Objective:

1. The objective of the course is to make the students understand the different techniques for efficient mining of the data.
2. To introduce students to the concepts, processes and practice of Inference Rules at different abstraction levels of Data.
3. To provide an understanding of the Data management perspective regarding the use of business intelligence (BI), Data Mining systems and Advanced Applications.

Detailed Syllabus

UNIT 1

Data Science :Introduction to Data Science, Overview, Motivation, Data Mining-Definition & Functionalities.

Data Warehousing: Overview, Definition, Delivery Process, Difference between Database System and Data Warehouse, Multi-Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept hierarchy, Process Architecture, 3 Tier Architecture, Data Marting.

(12L)

UNIT 2

Data Pre-Processing: Data Cleaning: Missing Values, Noisy Data,(Binning, Clustering, Regression, Inconsistent Data, Data Integration and Transformation.

Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Clustering, Discretization and Concept hierarchy generation.

Data objects and attribute types, Measuring Data Similarity and Dissimilarity, Cosine Similarity.

(7 L)

UNIT 3

Concept Description: Definition, Data Generalization, Analysis of attribute relevance, Mining Class comparisons, Statistical measures in large Databases. Measuring Central Tendency, Box Plots, Measuring Dispersion of Data, Apriori Algorithm, Mining Multilevel Association rules from Transaction Databases , FP-growth algorithm.

(7 L)

UNIT 4

Classification: What is Classification, Issues regarding Classification, Attribute selection measures, Information Gain, Gain Ratio, Gini Index, Decision tree, Naïve Bayesian Classification, Metrics for evaluating classifier performance, Confusion matrix.

(6 L)

UNIT 5

Cluster Analysis: Data types in cluster analysis, Overview of basic clustering methods, Partitioning methods: K-Means and K-medoids technique, Hierarchical Clustering: Agglomerative and Divisive, Density Based Methods :DBSCAN and OPTICS, Grid Based Methods: STING and CLIQUE, Outlier Analysis.

(8 L)

Learning Outcome

The course provides the students the ability to:

- 1 - Undertake systematic investigation/research related to the Data mining Concepts

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2- Understand advanced Database systems and technologies for today's dynamic business environment.

Text book [TB]:

1. Jiawei Han, Micheline Kamber, "Data Mining Concepts & Techniques" Elsevier.

Reference books [RB]:

1. M.H.Dunham, "Data Mining :Introductory and Advanced Topics" Pearson Education
2. Mallach, "Data Warehousing System" ,McGraw –Hill

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Applicable for 2017-2021

Subject Code	IT356	Subject Title	Multimedia						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4 th	Semester	VII

Course Objective:

1. To make students learn about basic understanding of the multimedia objects and tools for object generation
2. To teach students audio and video file formats used now days as a part of IT generation.
3. To make students learn clear understanding of multimedia projects.
4. To make students learn different compression techniques.

Detailed Syllabus

UNIT 1

Introduction: Introduction to Multimedia, Multimedia Information, Multimedia Objects, Multimedia in business and work, Stages of Multimedia Projects, presentation tools, tools for object generations, video, sound, image capturing, authoring tools, card and page based authoring tools (8 L)

UNIT 2

Multimedia Building Blocks: Text, Sound MIDI, Digital Audio, audio file formats, MIDI under windows environment Audio & Video Capture. (8 L)

UNIT 3

Data Compression: Introduction to data compression, Compression ratio, loss less & lossy compression, Huffman Coding, Shannon Fano Algorithm, Huffman Algorithms, Adaptive Coding, Arithmetic Coding ,Finite Context Modelling, Dictionary based Compression, Sliding Window Compression, LZ77,LZ78, LZW compression. (8 L)

UNIT 4

Image, Audio and Video Compression: Digital Audio concepts, Sampling Variables, Loss less compression of sound, loss compression & silence compression, lossy graphic compression, image file format, animations Images standards, JPEG Compression, Zigzag Coding, Multimedia Database. Content based retrieval for text and images, Video Compression, MPEG standards, MHEG Standard Video Streaming on net. (8 L)

UNIT 5

Advanced forms of interaction in Multimedia: Video Conferencing, Elements of (immersive/non-immersive) Virtual Reality, Augmented Reality, Tele presence, Mobile technologies.

Multimedia Security: Overview- Multimedia Systems, Secured Multimedia, Digital Rights Management Systems and Technical trends, Multimedia Encryption and Digital Watermarking, Security Attacks and Multimedia Authentication. (8 L)

Learning Outcome

At the end of the course, Learning Outcomes Having successfully completed this course, the student will demonstrate:

1. Students will understand various multimedia tools available.
2. Students will be able to learn with Multimedia projects

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3. Students can differentiate between lossy and lossless compression.

Text Book [TB]:

1. Tay Vaughan "Multimedia, Making IT Work" Osborne McGraw Hill, 7th edition
2. Khalid sayood "Introduction to data compression" Morgan Kaufmann Publishers, 3rd edition

Reference Book [RB]:

1. Buford "Multimedia Systems" Addison Wesley, 4th edition
2. Mark Nelson "Data Compression Book" BPB, 3rd edition
3. Sleinreitz "Multimedia System" Addison Wesley, 5th edition

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Subject Code	EC383	Subject Title	Consumer Electronics						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4 th	Semester	VII

Objectives of the Course: The students will learn

- Consumer Electronics and its application
- Concept of audio and video related system.
- Concepts of recording and power supplies.

UNIT-I

Audio Systems: Microphones, Loudspeakers, Speaker baffle and enclosure, Acoustics, Mono, Stereo, Quad, Amplifying Systems, Equalisers and Mixers, Electronic Music Synthesisers, Commercial Sound, Theater Sound System

8LU

UNIT – II

Video Systems and Displays: Monochrome TV, Colour TV standards and systems, TFT, Plasma, HDTV, Digital TV, Video Telephone and Video Conferencing

8L

UNIT III:

Domestic Appliances: Washing machines, Microwave ovens, Air- conditioners and Refrigerators, In car computers Office Systems: FAX, Xerox, Telephone Switching System, Mobile Radio System

8L

UNIT IV:

Recording and Reproduction Systems: Disc recording and reproduction, Magnetic recording and reproduction, Video tape recording and reproduction, Video disc recording and play back, Distortion and Noise reduction in Audio and Video System

8L

UNIT-V

Power Supplies and other systems: SMPS, UPS and Preventive Maintenance, Set Top Boxes, Remote controls, Bar codes, ATM

8L

Text Books:

1. Consumer Electronics S P Bali Pearson ed 2005

OUTCOMES OF THE COURSE:

The course provides an understanding of:

- Electronic systems related to consumer applications.
- Principle of working of various home appliances.
- Skills to use modern consumer electronics systems used in day to day life.

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Subject Code	EC385	Subject Title	Analog Electronics						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4 th	Semester	VII

Objectives of the Course: To teach the fundamental concepts of various electronic devices, circuits and their application. To develop ability among students for problem formulation, system design and solving skills.

UNIT-I

Semiconductor materials and properties Group-IV materials, Covalent bond, electron-hole concepts Basic concepts of energy bands in materials, concepts of forbidden gap Intrinsic and extrinsic semiconductors, donors and acceptors impurities **4L**

UNIT-II

Junction diode and diode applications p-n junction, depletion layer, v- i characteristics, diode resistance, capacitance diode ratings (average current, repetitive peak current, non-repetitive current, peak-inverse voltage). **4L**

Diode Applications Rectifiers (half wave and full wave), filter (C – filter), clipping circuits, clamping circuits, voltage multipliers **4L**

UNIT-III

Breakdown diodes Breakdown mechanisms (zener and avalanche), breakdown characteristics, zener diode application as shunt regulator **4L**

UNIT-IV

Bipolar Junction Transistor Basic construction, transistor action, CB, CE and CC configurations, input/output Characteristics, Transistor Amplifier Graphical analysis of CE amplifier, concept of voltage gain, current gain. **6L**

UNIT-V

Field Effect Transistor

JFET: Basic construction, transistor action, concept of pinch off, maximum drain saturation current, input and transfer characteristics, characteristics equation CG, CS and CD configurations, MOSFET: depletion and enhancement type MOSFET-construction, operation and characteristics.

6L

Reference Books:

1. Boylestad and Nashelsky, 'Electronic Devices and circuits' PHI, 6e, 2001.

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2. A Mottershead, 'Electronic devices and circuits'. PHI, 2000.
3. Morris Mano, 'Digital Computer Design', PHI, 2003.
4. R.K. Singh & Ashish, Basic Electronics Engg. Laxmi Publication, 2007.
5. Milman & Halkias, Integrated electronics Electronics, PHI, 2005.

OUTCOME OF THE COURSE:

- Students will be able to build, develop, model, and analyze the electronic circuits along with learning the device ratings and characteristics
- Students will be able to design and analyse electronic circuits

List of Experiments:

1. To study V-I characteristics of p-n junction diode.
2. To study V-I characteristics of zener diode.
3. To study half-wave rectifier and calculate ripple factor and efficiency.
4. To study full-wave rectifier and calculate ripple factor and efficiency.
5. To study clipper circuits.
6. To study clamper circuits.
7. To study the input and output characteristics of CB and CE transistor.
8. To study drain and transfer characteristics of JFET.

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Applicable for 2017-2021

Subject Code	EE481	Subject Title	NEW AND RENEWABLE ENERGY SOURCES						
LTP	3 0 0	Credit		Subject Category	Open Elective	Year	4th	Semester	VII

Objectives of the Course

- To introduce fundamentals of various renewable energy source
- To introduce fundamentals of technologies used to harness usable energy from solar, wind,
- To introduce fundamentals of technologies used to harness usable energy from ocean and Biomass energy sources.

Unit 1	Introduction :Energy resources and their classification, oil crisis of late 20th century and its impacts on energy planning, consumption trend of primary energy sources, world energy future, energy audit and energy conservation, energy storage.	8L
Unit 2	Solar Energy Conversion :Solar resources, passage through atmosphere, solar thermal energy conversion: solar energy collectors, solar thermal power plant, solar PV conversion: solar PV cell, V-I characteristics, MPPT, Solar PV power plant and applications.	8L
Unit 3	Biomass Energy Conversion : Usable forms of Bio Mass, Biomass energy resources, biomass energy conversion technologies, ethanol blended petrol and diesel, biogas plants. Energy farming.	8L
Unit 4	Wind Energy Conversion : Wind Power: Energy estimation, Power extraction, lift and drag forces, horizontal axis wind turbine, vertical axis wind turbine, wind energy conversion and control schemes, environmental aspects.	8L
Unit 5	Other Alternate Energy Sources/Technologies: Geothermal Energy: geothermal fields, types, geothermal energy generation systems, ocean tidal energy systems, fuel cell: basic operation and classification, principle of MHD generation, output voltage and power, environmental aspects.	8L

Text Books:

1. B.H. Khan, Non conventional Energy Resources, 2nd edition, 2009.

Reference Books

1. G.D. Rai, Non Conventional Sources of Energy, (Khanna Publishers).
2. J.W. Twidell& A.D. Weir, Renewable Energy Resources, (ELBS / E. & F.N. Spon., London).
3. Godfrey Boyle, Renewable Energy, Oxford, 2nd edition 2010.

Outcome of the Course:

- Identify renewable energy sources.
- Understand the mechanism of solar, wind and ocean energy sources.
- Demonstrate the understanding of various technologies involved in power generation from renewable energy sources.

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Subject Code	PE481	Subject Title	Fuel Technology						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4 th	Semester	VII

1. Course Summary

This course will introduce students to classification of fuel and their properties. In this course, students unable to understand coal preparation, coal storage process, coal gasification process. This course also covers various topics which includes Fischer Tropsch Synthesis, Gaseous and liquid fuels i.e. natural gas, producer gas, water gas, coal gas, biogas, LPG, kerosene, diesel. Students will also learn combustion mechanism for solid, liquid and gaseous fuel.

2. Course Objectives

The students should be able to:

1. Understand different types of fuel, basic terms in fuels and combustion
2. Understand the coal preparation and conversion of coal into suitable products using gasification and Fishers Tropsch Synthesis process.
3. Understand physical and chemicals properties of different types of fuel and their storage techniques, combustion mechanism

3. Course Outcomes

A good knowledge of this course will enable students to:

1. Understand origin of different of types of fuel and their properties and classification
2. Understand the Coal preparation and storage techniques, Physical and chemical properties of coal, Briquetting and liquefaction of solid fuels
3. Understand the conversion of coal into useful products using gasification techniques and Fischer Tropsch Synthesis
4. Understand about gaseous and liquid fuels, their physical and chemical properties and Testing methods for these fuels
5. Understand about combustion mechanism for different types of fuels and Furnace elements.

4. Curriculum Content

UNIT 1

Classification of Fuel- Solid Fuels, Liquid Fuels, Gaseous Fuels, Various Terms Related to the Study of Fuels and Combustion. Coal-Origin, Composition, Petrography, Analysis and Properties of Coal, Classification of coal

UNIT 2

Coal Preparation, Coal Storage, Coal Carbonization and by-product Recovery. Physical and Chemical, Properties of Coke. Briquetting of Solid Fuels. Liquefaction of Solid Fuels

UNIT 3

Coal: A Source of Energy- Gasification of Coal. Fixed Bed Gasification, Fluidized Bed Gasification, Entrained Bed Gasification. Integrated Gasification Combined Cycle (IGCC). Underground Gasification of Coal. Indian Scenario related to Coal Gasification. Coal to Liquid (CTL) via Fischer – Tropsch (F-T) Synthesis.

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UNIT 4

Gaseous and Liquid Fuels- Natural gas, Producer gas, Water gas, Carbureted Water gas, Coal gas, Gases from biomass, LPG. Gasoline, Kerosene, Diesel. Physico Chemical Properties and Testing of Liquid Fuels. Coal Tar Fuels (CTF).

UNIT 5

Combustion: General Principle of Combustion, Combustion of Solid Fuels – Grate Firing and Pulverized Fuel Firing System. Combustion of Liquid Fuels, Burners for Liquid and Gaseous Fuels Combustion

Text book [TB]:

1. Kuo, K.K., Principles of Combustion, John Wiley and Sons, Inc. (2005).
2. Sarkar, S., Fuels and Combustion, Orient Longman, (1990).

Reference books [RB]:

1. Sharma, S.P., and Chander, M., Fuels and Combustion, Tata McGraw Hill (1984)

5. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

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Subject Code	PE482	Subject Title	Health Safety and Environment in Industry						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4 th	Semester	VII

1. Course Summary

The course will introduce students to the need and scope of health, safety and environment in industry. The students will learn about the sources and causes of pollution, effects of the pollutants on livings and environment, and the safety and remedial measures that should be adopted to reduce the pollution.

2. Course Objectives

The students should be able to:

1. Understand the sources of pollutions.
2. Understand the effects of pollutions on health and environment.
3. Understand the remedial measures and safety precautions associated with each source of pollution.

3. Course Outcomes

On successful completion of the course, students have the understanding of the following:

1. Understand the scope of HSE in industry.
2. Understand the sources, effects and remedies of air pollution.
3. Understand the sources, effects and remedies of water pollution.
4. Understand the sources, effects and remedies of liquid and solid wastes.
5. Understand the sources, effects and remedies of noise pollution.

4. Curriculum Content

UNIT 1

Introduction: Man And Environment: Overview (Socio-Economic Structure & Occupational Exposures); Scope Of Environmental Engineering; Pollution Problems Due To Urbanization & Industrialization.

UNIT 2

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 Of Gaseous Air Pollutants; Collection Of Particulate Pollutants; Analysis Of Air Pollutants Like : Sulphur Dioxide, Nitrogen Oxide, Carbon Monoxide, Oxidants & Ozone; Hydrocarbons; Particulate Matter; Control Of Particulate Emission- Control Of Gaseous Emission; Flue Gas Treatment Methods : Stacks Gravitational And Inertial Separation; Settling Chambers; Dynamic Separators; Cyclone; Filtration; Liquid Scrubbing; Spray Chambers; Packed Towers; Orifice And Venturi Scrubbers; Electrostatic Precipitators.

UNIT 3

Water Pollution & Its Control - Origin Of Waste Water – Types Of Water Pollutants And Their Effects ; Adverse Effects On: Human Health & Environment; Aquatic Life; Animal Life; Plant Life; Water Pollution Measurement Techniques; Water Pollution Control Equipments& Instruments; Indian Standards For Water Pollution Control.

UNIT 4

Liquid & Solid Wastes – Domestic & Industrial Wastes; Pesticides; Toxic: Inorganic & Organic Pollutants; Soil Deterioration; 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.

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UNIT 5

Noise Pollution & Control: Intensity; Duration; Types Of Industrial Noise; Ill Effects Of Noise; Noise Measuring & Control; Permissible Noise Limits.

Text book [TB]:

1. J. Turk & A. Turk, "Environmental Science Environmental Pollution".

Reference books [RB]:

1. Odum, "Fundamental of Ecology.

5. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

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Applicable for 2017-2021

Subject Code	MA541	Subject Title	STATISTICAL TECHNIQUE AND APPLICATIONS						
LTP	3 0 0	Credit	3	Subject Category	Open Elective	Year	4 th	Semester	VII

OBJECTIVE: The objective of this subject is to give the basic knowledge of descriptive and mathematical part of statistics. Applications of various probability distribution in the field of insurance and finance. The course will focus on the different situations in the field of actuarial science which can be dealt with transformation of variables. The course will make able the students to understand the association between two random quantities and to find their mathematical measure.

Unit I

Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, absolute moments, factorial moments, skewness and kurtosis, Sheppard's corrections.

Unit II

Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation, rank correlation. Simple linear regression.

Unit III

Principle of least squares and fitting of polynomials and exponential curves. Theory of attributes Independence and association of attributes, consistency of data, measures of association and contingency, Yule's coefficient of colligation.

Unit IV

Testing of hypothesis: Z-test, t-test, F-test, Chi-square test for goodness of fit, Introduction to analysis of variance.

LEARNING OUTCOME: Students will able to:

- Analyze given statistical data.
- Have confidence to deal with real life situation, especially, in insurance and finance.
- Understand applications of standard probability distributions in every span of life.
- Find the association between two random quantities using mathematical theory.

Text Books:

1. Gupta, S.C. and Kapoor, V.K. (2007): Fundamental of Mathematical Statistics, 11th Edition. (Reprint), Sultan Chand & Sons.
2. Y.P. Agarwal (2012) Statistical Methods: Concepts, Application and Computation, 3rd edition; Sterling Publishers.

Reference Books:

3. Freund E F John, Mathematical statistics, 6th edition, Prentice Hall International, 1999.
4. Hogg, R. V. and Craig, T. T. (1978) Introduction to Mathematical Statistics (Fourth Edition) (Collier-McMillan).
5. Rohatgi, V. K. (1988) Introduction to Probability Theory and Mathematical Statistics (Wiley Eastern).

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Code	AR-481	Subject Title	GRAPHICS & PRODUCT DESIGN						
LTP	3 0 0	Credit	3	Subject Category	OE	Year	4 th	Semester	VII

Course Objective:

To introduce the various aspects of graphics design and important stages of product design and development.

Unit 1: Introduction

Introduction and importance of graphics and product design. Principles and elements of design. History of Design. Colour Theory. Techniques and processes to communicate graphically.

Unit 2: Product Design Cycle

Stages of product development. Introduction to ergonomics

Unit 3: Design Process

Introduction to concept. Concept development. Role of sketching in concept development. Implementation stages of concept for product development

Unit 4: Technology & Market Assessment

Customer needs identification, Market research essentials. Advertising and marketing tools.

Unit 5: Design Tools

Introduction to various design tools.

LEARNING OUTCOME:

1. The student will be able to understand the importance of Graphics.
2. The students will be able to understand and demonstrate their ideas visually.
3. The students will be able to understand the various stages of product development.

Text Books:

1. The Elements of Graphic Design, Alex W. White
2. The Design of Everyday Things, Don Norman

Reference Books:

1. Product Design & Development, Karl T. Ulrich & Steven D. Eppinger

Course Structure of B.Tech. – Mechanical Engineering

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Subject Code	ME381	Subject Title	Entrepreneurship and Startup						
LTP	2 0 2	Credit	3	Subject Category	UC	Year	4 th	Semester	VII

COURSE OBJECTIVE:

To understand the basic concepts Entrepreneurship and start up. To understand role and importance of entrepreneurship for economic development. To develop personal creativity and entrepreneurial initiative or start up.

COURSE OUTCOME

At the end of the course the student can:

CO1: Analyse the business environment in order to identify start up opportunities

CO2: Identify the elements of success of entrepreneurial ventures

CO3: Consider the legal and financial conditions for starting a start up

CO4: Evaluate the effectiveness of different entrepreneurial strategies

Unit 1:

4Hrs.

Conceptual definition of entrepreneurs, entrepreneurship and start up. Historical development of entrepreneurship. Entrepreneurship in economic theory. Entrepreneurial practice. Impact of Entrepreneurship on society. The role of entrepreneurship in economic development. Role of innovation in entrepreneurship.

Unit 2:

6Hrs.

Entrepreneurial economy. Entrepreneurship and Economic Development. Type of Entrepreneurship. Entrepreneur and small business. Features and types of entrepreneurs. Terms of entrepreneurship. Sources of business ideas. Technical and technological analysis of entrepreneurial projects. Designing a business investment. Angel Investor and Venture capitalist – Roles and Importance.

Unit 3:

5Hrs.

Forms of entrepreneurial organization. Entrepreneurial process. Entrepreneurial and start-up strategies. Role of Government agencies in Entrepreneurship development. Entrepreneurial project: entrepreneurial venture and entrepreneurial development chain. Knowledge of business economy. Group based strategies development.

Unit 4:

5Hrs.

Sources of capital. Market Research, Understanding the Market need for your concept. Defining the business concept and formulating a business plan for startup. Fundamentals of entrepreneurial management. Business process: product design, operational art, stock management.

Unit 5:

6Hrs.

Entrepreneurbiographies - the actual successes and failures. Exit strategies for entrepreneurs. Case studies of : Successful Entrepreneurial Ventures, Failed Entrepreneurial Ventures and Turnaround Ventures. Some case studies related to Product & Technology.

TEXT BOOKS:

1. S.S.Khanka, "Entrepreneurial Development". S.Chand & Co. Ltd.,10th edition, 2014.
2. Kuratko & Hodgetts, "Enterprenuership –Theory, process and practices", Thomson learning 6th edition, 2016.
3. Donald F Kuratko, "Enterprenuership – Theory, Process and Practice", 9th Edition, Cengage Learning 2014.

REFERENCE:

1. Hisrich R D and Peters M P, "Entrepreneurship". Tata McGraw-Hill. 9th Edition, 2014.
2. Rabindra N. Kanungo "Entrepreneurship and innovation", Sage Publications, 1998.

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3. EDII “Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development” Institute of India, Ahmadabad, 1986.
4. Rajeev Roy, ‘Entrepreneurship’ 2nd Edition, Oxford University Press, 2011.
5. Mathew J Manimala, “Enterprenuership theory at cross roads: paradigms and praxis” 2nd Edition Dream Tech, 2005.

EVALUATION BREAKUP:

- Case study – 25 Marks (Internal)
- Assignments – 10 Marks (Internal)
- Mid Term Evaluation of Project – 10 Marks (Internal)
- Startup Idea, Seminar - 15 Marks (External)
- End Term Evaluation of Project – 40 Marks (External)

*The End Term evaluation will consist of 25 to 30 minutes’ presentation followed by questionnaire by External Experts.

RESOURCE PERSONS FROM VARIOUS DEPARTMENTS:

- Mechanical Engineering
- MBA
- Computer Science Engineering.
- Information Technology.
- Industry Persons.
 1. Experts from Industry – As recommended by STPI
 2. Dr Umakant Panwar – Entrepreneur
 3. Mr Vivek Harinarian - Entrepreneur.

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME452	Subject Title	Solar Energy Systems						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: To provide students an overview of world's energy resources & their impact on environment. To highlight the importance of renewable energy sources with focus on solar energy and its importance in the context of limited supply of conventional resources & global warming. To impart essential technical knowledge of solar energy systems & their applications

Course Pre/Co- requisite (if any): Heat transfer

Detailed Syllabus

UNIT 1: Energy Resources & Solar Radiation

Introduction: Energy demand & supply; world's production & reserves of commercial energy sources; energy crisis – causes & options; alternative energy resources; Sun as a source of energy.

Solar radiation outside the earth's atmosphere & at the earth's surface, solar constant; spectral distribution of solar radiation; measurement of solar radiation; solar radiation data & geometry; solar radiation on horizontal & inclined surfaces; predicting the availability of solar radiation.

UNIT 2: Flat Plate Collectors

An overview of solar thermal collection & applications; conventional liquid flat plate collectors; performance analysis; transmissivity-absorptivity product; collector efficiency & heat removal factor; effect of various parameters on performance; analysis of collectors similar to the conventional collector; alternatives to the conventional collector.

UNIT 3: Concentrating Collectors

Description, classification and types of concentrating collectors; general characteristics; analysis of flat plate collector with plane reflectors; cylindrical parabolic collector – orientation, tracking modes, and performance analysis; linear reflector Fresnel collector; paraboloid dish collector; central receiver collector.

UNIT 4: Solar Thermal Applications

Solar water heating – natural & forced circulation systems; solar space heating using liquid flat collectors – active & passive methods; solar space cooling & refrigeration; solar drying & cooking; solar air heaters; solar electric power generation; solar thermos-mechanical systems; solar thermal energy storage – sensible, latent, and thermochemical storage; solar ponds.

UNIT 5: Solar Photovoltaic Systems

Fundamentals of photovoltaic conversion; description and basic principle of working of a solar cell; performance characteristics of a solar cell; maximum & actual conversion efficiencies; types of solar cells; solar cell, module, and array construction; photovoltaic systems and applications; stand-alone systems with battery storage & grid interactive systems; hybrid photovoltaic & thermal systems

Learning Outcome

At the end of the course the student can:

CO1: Understand about the interaction between energy, economy, environment, and social development.

CO2: Appreciate the importance of future energy systems based on solar energy.

CO3: Possess the basic technical knowledge to develop energy systems based on solar energy.

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

Text book [TB]:

1. S. P. Sukhatme & J. K. Nayak, "Solar Energy", 4th edition (2018), McGraw Hill Education (India) Private Limited, Chennai.
2. Napoleon Enteria, Aliakbar Akbarzadeh Solar Energy Sciences and Engineering Applications, CRC Press, 2013

Reference books [RB]:

1. J. A. Duffie & W. A. Beckman, "Solar Engineering of Thermal Processes", 4th edition (2013), Wiley
2. Soteris A. Kalogirou, Solar Energy Engineering: Processes and Systems, Academic Press, 2009

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME453	Subject Title	Machine Tool Design						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: To enable the students design tools, dies, jigs and fixtures and analyse and optimize an existing jig and fixture.

Course Pre/Co- requisite (if any): Design of Machine Elements, Manufacturing Processes

Detailed Syllabus

UNIT 1: Introduction and General Principles of Machine Tool Design

Developments in machine tools, Types of machine tools, Constructional and Operational Features of basic machine tools e.g. Lathe, Drill, Milling, Shapers and Planers, Grinding machine etc., General requirement of machine tool design, Machine tool design process, Tool wear, Force Analysis.

UNIT 2: Machine Tools Drives

Classification of machine tool drives, Group vs Individual drives, Selection of electric motor, A brief review of the elements of mechanical transmission e.g. gear, belt and chain drives, slider-crank mechanism, cam mechanism, nut & screw transmission, Devices for intermittent motion, Reversing & Differential mechanisms, Couplings and clutches, Elements of hydraulic transmission system. e.g. pumps, cylinder, directional control valves, pressure valves etc., Fundamentals of kinematic structure of machine tools.

UNIT 3: Regulation of Speed and Feed rates

Laws of stepped regulation, Selection of range ratio, Standard progression ratio, Selection of best possible structural diagram, Speed chart, Design of feed box, Developing gearing diagrams, Step-less regulation of speed and feed in machine tool, Speed and feed control.

UNIT 4: Design of Machine Tool Structure

Function of machine tool structures and their requirements, Design criteria for machine tool structures, Selection of material, Basic design procedure for machine tool structures, Design of bed, column and housing, Model technique in design, Design of guide ways and power screws: basic guide way profiles, Designing guide way for stiffness and wear resistance, Hydrostatic and antifriction guide ways, Design of sliding friction power screws, Design of spindle & spindle supports, Layout of bearings, selection of bearings for machine tools.

UNIT 5: Dynamics of machine tools

General procedure for assessing the dynamic stability of cutting process, closed loop system, Chatter in machine tools. Control Systems: Functions, requirements & types of machine tool controls, Controls for speed & feed change, Automatic and manual Controls, Basics of numerical controls, Machine tool testing: Geometrical tests on Lathe, Milling and Drilling machines, their performance & significance

Learning Outcome

At the end of the course the student can:

CO1: Identify the importance of work holding device.

CO2: Design jigs and fixtures.

CO3: Calculate the required specifications of a press for required operations.

CO4: Design tools and dies for required operations.

Text book [TB]:

3. N.K. Mehta, "Machine Tool Design and Numerical Control" 3rd Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2012.

Reference books [RB]:

1. S.K. Basu and D.K. Pal, "Design of Machine Tools", 5th Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2009
3. G.C. Sen and A. Bhattacharya, "Principles of Machine Tools", Second Edition, New Central Book Agency (P) Ltd., Kolkata, 2009

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME454	Subject Title	Principle of Management						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: To enable the students design tools, dies, jigs and fixtures and analyse and optimize an existing jig and fixture.

Course Pre/Co- requisite (if any): Industrial Engineering and Management

Detailed Syllabus

UNIT 1:

Definition of management, science or art, manager vs entrepreneur; Types of managers managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management.

UNIT 2:

Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes..

UNIT 3:

Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management.

UNIT 4:

Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

UNIT 5:

Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

Learning Outcome

CO1: Get a clear understanding of management functions in an organization.

CO2: Get knowledge about budgetary and non-budgetary system.

CO3: Students will understand the management technique controlling of system.

Text book [TB]:

1. Robins S.P. and Couiter M., Management, Prentice Hall India, 10th ed., 2009.
2. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999

Reference books [RB]:

1. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.
2. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME455	Subject Title	Advanced Engineering Materials						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: To enable the students design tools, dies, jigs and fixtures and analyse and optimize an existing jig and fixture.

Course Pre/Co- requisite (if any): Materials Engineering

Detailed Syllabus

UNIT 1: Equilibrium and kinetics

Stability and metastability, basic thermodynamic function, statistical nature of entropy and kinetics of thermally activated process. Introduction to crystal structure and crystal imperfections Radius ratio rule. Diamond cubic structure and structure of graphite.

UNIT 2: Diffusion in solid

Fick's law of diffusion, Solution to Fick's law of diffusion, application of Fick's law, Kirkendall effect, atomic model of diffusion in solid, vacancy and interstitial model of diffusion and the mathematical modeling. Phase transformation: Gibbs phase rule, Lever rule, some typical phase diagram. Nucleation and growth, Nucleation and growth kinetics, growth and overall transformation kinetics, transformation in steel and effect of alloying in steel and in cast iron. Precipitation process, solidification and crystallization, Glass transition, recovery re-crystallization and grain growth. Strengthening mechanism, Hall pitch relation.

UNIT 3: Plastic deformation

Mechanism of plastic deformation, shear strength of perfect and real crystal, stress required to move a dislocation. Effect of temperature in dislocation motion, multiplication of dislocation during deformation, effect of solute atom and grain size on dislocation motion. Fracture: Ductile and brittle fracture, Fracture toughness, ductile brittle transition, fracture mechanism map, method of protection against fracture.

UNIT 4: Composites Polymer

Polymer, metal-metal, ceramic –ceramic, ceramic-polymer, metal-ceramic, metal polymer composites. Dispersion reinforced, particle reinforced, laminated and fibre reinforced composites. Mechanical behaviour of polymer, ceramic and composite.

UNIT 5: Elastomers and Miscellaneous

Types, properties and identifications of different types of rubbers vulcanization, fabrication and forming techniques of rubber. Introduction of plastics and ceramics – types, application and process. Smart materials-introduction and types. Selection of materials and factors effecting deflection, Selection process and systematic evaluation.

Learning Outcome

At the end of the course the student can:

CO1: Get a clear understanding of advanced engineering materials.

CO2: Student will understand about process of development of composite.

CO3: Students will get the knowledge about basic fundamental of materials.

Text book [TB]:

1. Raghvan, V., "Materials Science and Engineering," PHI Learning Private Limited, 2013.
2. Mittermeijer, Eric J. "Fundamentals of Materials Science: The Microstructure–Property Relationship Using Metals as Model Systems", Springer verlag Berlin Heidelberg, 2010

Reference books [RB]:

1. Van Vlack, L. H. "Elements of Materials Science and Engineering, Pearson Education India,
2. Callister W. D. & Rethwisch, D. G. , "Materials Science and Engineering: An Introduction" John Wiley & Sons, 2006

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	ME456	Subject Title	Non-Destructive Testing						
LTP	2 0 2	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: To understand the basic principles underlying each NDT technique and become familiar with common types of defects arising in different types of manufactured products and the NDT method(s) best suited to evaluate them.

Course Pre/Co- requisite (if any): Manufacturing Processes

Detailed Syllabus

UNIT 1: Introduction to NDT

Introduction to non-destructive testing and evaluation, visual examination, liquid penetrant testing and magnetic particle testing. Advantages and limitations of each of these techniques.

UNIT 2: Radiographic Testing

Radiography principle, electromagnetic radiation sources, X-ray films, exposure, penetrometer, radiographic imaging, inspection standards and techniques, neutron radiography. Radiography applications, limitations and safety.

UNIT 3: Eddy Current and Ultrasonic Testing

Eddy current principle, depth of penetration, eddy current response, eddy current instrumentation, probe configuration, applications and limitations. Properties of sound beam, ultrasonic transducers, inspection methods, flaw characterization technique, immersion testing.

UNIT 4: Special/Emerging Techniques

Leak testing, Acoustic Emission testing, Holography, Thermography, Magnetic Resonance Imaging, Magnetic Barkhausen Effect. In-situ metallography.

Study of defects in castings, weldments, forgings, rolled products etc. and defects arising during service. Selection of NDET methods to evaluate them. Standards and codes.

Learning Outcome

At the end of the course the student can:

CO1: Develop NDT techniques for various products.

CO2: Select of appropriate NDT technique(s) for new inspection jobs.

CO3: Students will get the knowledge about various methods or non-destructive testing.

Text book [TB]:

1. Baldevraj, Jayakumar T., Thavasimuthu M., (2008) "Practical Non-Destructive Testing", 3rd edition, Narosa Publishers.
2. Ravi Prakash, "Nondestructive Testing Techniques", New Age International Publishers, 1st rev. edition, 2010.

Reference books [RB]:

1. American Society for Metals, "Non-Destructive Evaluation and Quality Control": Metals Hand Book: 1992, Vol. 17, 9th Ed, Metals Park, OH.
2. Paul E Mix, "Introduction to nondestructive testing: a training guide", Wiley, 2nd edition New Jersey, 2005.

Course Structure of B.Tech. – Mechanical Engineering

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Applicable for 2017-2021

Subject Code	ME457	Subject Title	Welding Technology						
LTP	2 0 2	Credit	3	Subject Category	DE	Year	4 th	Semester	--

Course Outline:

Course Objective: To understand the basic principles of welding and various types of advanced joining processes also to know about welding defects and remedial measures for it.

Course Pre/Co- requisite (if any): Manufacturing Processes

Detailed Syllabus

UNIT 1: Power sources

Classification of welding processes - heat sources, power sources, arc characteristics, V-I relationship, different types of electrodes, ingredients and function of electrode coverings, types of weld joints.

UNIT 2: Fusion welding processes and Welding metallurgy

Shielded metal arc welding, gas welding, TIG welding, MIG welding, Submerged arc welding processes. Weld thermal cycles and their effects, effects of pre and post weld heat treatments, concept of HAZ, concept of weldability and its assessment. Welding of different materials, defects in welds, their causes and remedies.

UNIT 3: Solid state welding processes

Resistance, friction, friction stir, ultrasonic, induction pressure, diffusion welding processes, explosive welding.

UNIT 4: Special welding processes

Electron beam, laser beam welding, plasma arc processes; advantages, limitations, Introduction to Robotic welding, underwater welding.

Learning Outcome

At the end of the course the student can:

CO1: Develop welding techniques for various alloys

CO2: Develop mechanized welding techniques.

CO3: student will understand the fundamental of welding methods and mechanism (principle)

Text book [TB]:

1. Cornu. J.,(2004)"Advanced Welding Systems"-Volumes I, II and III, JAICO Publishers.
2. Lancaster L.F, (1996) 'The Physics of Welding', Pergamon Press.

Reference books [RB]:

1. Welding Handbook (Section I) American Welding Society 1999
2. Parmer R.S, (2005) "Welding processes", Khanna publishers.
3. Srinivasan N.K, (2004) "Welding Engineering", Khanna publishers.
4. Rao P.N – (1998)"Manufacturing Technology (Foundry, Forming and Welding) II Edition", Tata McGraw Hill Pub. Co. Ltd, New Delhi.

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

Humanities Electives III

Subject Code	HS493	Subject Title	Indian Culture & Tradition						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	IV	Semester	VIII

Course Objective

- To promote an integral and holistic growth of young minds
- Develop a broad understanding of Indian society and intercultural literacy through cultural immersion.
- Deepen your knowledge of Indian development, environmental, and cultural issues through coursework, local engagement, and independent projects.

Unit 1 Indian Culture: An Introduction

8Hrs.

Characteristics of Indian culture, Significance of Geography on Indian Culture; Society in India through ages- Ancient period- Varna and Caste, family and marriage in India, position of women in ancient India, Contemporary period; caste system and communalism.

Unit 2 Indian Languages and Literature

6 Hrs.

Evolution of script and languages in India: Harappan Script and Brahmi Script; Short History of the Sanskrit literature: The Vedas, The Brahmins and Upanishads & Sutras, Epics: Ramayana and Mahabharata & Puranas.

Unit 3 Brief History of Indian Arts and Architecture

6Hrs.

Indian Art & Architecture: Gandhara School and Mathura School of Art; Hindu Temple Architecture, Buddhist Architecture, Medieval Architecture and Colonial Architecture.

Indian Painting Tradition: ancient, medieval, modern Indian painting and Odishan painting tradition *Performing Arts:* Divisions of Indian classical music: Hindustani and Carnatic, Dances of India: Various Dance forms: Classical and Regional, Rise of modern theatre and Indian cinema.

Unit 4 Spread of Indian Culture Abroad

6Hrs.

Causes, Significance and Modes of Cultural Exchange - Through Traders, Teachers, Emissaries, Missionaries and Gypsies, Indian Culture in South East Asia India, Central Asia and Western World through ages

COURSE OUTCOME:

- Understand background of our religion, customs institutions, administration and so on.
- Understand the present existing social, political, religious and economic conditions of the people.
- Analyze relationship between the past and the present relevance of Indian tradition.
- Develop practical skills helpful in the study and understanding of historical events.

TEXT BOOKS

1. Chakravarti, Ranabir: Merchants, Merchandise & Merchantmen, in: Prakash, Om (ed.): The Trading World of the Indian Ocean, 1500-1800 (History of Science, Philosophy and Culture 361 in Indian Civilization, ed. by D.P. Chattopadhyaya.
2. Chaudhuri, Kirti N.: Trade and Civilisation in the Indian Ocean, CUP, Cambridge, 1985.
3. Malekandathil, Pius: Maritime India: Trade, Religion and Polity in the Indian Ocean, Primus Books, Delhi, 2010.
4. McPherson, Kenneth: The early Maritime Trade of the Indian Ocean, in: ib.: The Indian Ocean: A History of People and The Sea, OUP, 1993, pp. 16-75.
5. Christie, J.W., 1995, State formation In early Maritime Southeast Asia, BTLV

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

Humanities Electives III

Subject Code	HS483	Subject Title	Indian Philosophy						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	IV	Semester	VIII

Course Objective

- Develop an understanding of Indian philosophical systems
- To empower for self-exploration

Unit 1 Introduction

11Hrs.

Meaning of Philosophy, Origin of Philosophy in India, Major Indian philosophical systems: Sankhya: Metaphysics, Theory of causation, Prakriti, Purusha, Evolution, Yoga: Concept of Chitta, Types and Modification of Chitta, Eight-fold Yoga & Vedant: Notions of Maya & Brahma

Unit 2 Major Principles

5Hrs.

Panchkosha, Triguna, Tridosh, Macrocosm-Microcosm

Unit 3 Major Contemporary Indian Philosophers

6Hrs.

Lord Buddha, Mahaveer, Gandhi, Vivekanand, Aurovindo-The Life Divine, Pt. Sri Ram Sharma Acharya, Vinoba & Acharya Rajneesh Osho, Paramhans Yogananda-Autobiography of a Yogi

Unit 4 Activities & Projects

4Hrs.

Identifying human prakriti, Using Trigun inventory, Understanding self

COURSE OUTCOME:

- Students will acquire understanding of concepts of Indian philosophy.
- Students will be enabled to analyze their self.
- The students will be able to relate some of the core concepts and theories of modern Indian philosophy to concepts and ideas in classical Indian philosophy.
- The students will be able to appreciate how philosophical approaches may be integrated more practically as a “way of life”.

TEXT BOOK

Chattejee, S.G. and Datta, D.M. (1960) An Introduction to Indian Philosophy, Calcutta: University of Calcutta Press

REFERENCE BOOKS

- The Yoga Sutras of Patanjali: (annotated commentary) (Divine Cool Breeze Realized Writers Book 15) by Shri Patanjali, Shri Mataji Nirmala Devi (Introduction), Charles Johnson (Translation)
- Acharya, Pt. Sri Ram Sharma (2015). Gayatri Mahavigyan. Mathura: Akhand Jyoti Prakashan.
- Vinoba, Acharya (2011). Vichar Pothi. Purnar: Paramdham Prakashan.
- Gandhi, M.K. (2013). The story of my experiments with truth. Varanasi: Sarvodaya Prakashan.

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

Humanities Electives III

Subject Code	HS491	Subject Title	Industrial Sociology						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	IV	Semester	VIII

Course Objective

- The course attempts to analyze the structure and process of industrial organizations from the sociological perspective.
- The course enables students to have a general view of modern industry.

Unit 1

7Hrs.

Industrial Sociology: Nature, Scope and Importance, Origin and Development, Industry as a social, System, Development of Industry in Post-Independence period, Evolution of Working Class, Changing nature of work, Growth of unorganized informal sector., Dynamics of Industrial Relations: Approaches to the study of Industrial Relations, Collective Bargaining, – Concepts, Types, Scope and Importance.

Unit 2

7Hrs.

Industrial Disputes: Concept, Features and Kinds of disputes, Settling disputes, Mediation, Arbitration, Conciliation, Negotiation, The Indian Worker: Features of Indian worker, the contribution of social - Philosophy, family, caste and community in determining the attitude of workers

Unit 3

6Hrs.

Trade Union: Concept, Features, Functions and Types, History of Trade Union Movement in India Trade Unions and Challenges of Privatization and Globalization; Law and work, Decline of Trade Unions.

Unit 4

6Hrs.

Dynamics of Industrial Relations: Corporate Social Responsibility, Inclusion of Women in the Corporate Sector, Scope of Industrial Sociology in India; Impact on Employment, Impact on HRD, impact on wages and benefits, Modern Industry in India

COURSE OUTCOME:

- It will enable students to demonstrate the different human components that make up modern industry.
- The student will get exposed to a specialized area of sociology and its insights.
- Apply sociological concepts and theories to understand contemporary social issues and/or public debates about these issues
- Communicate sociological concepts and/or research in a manner that is appropriate for the intended audience (e.g., academic, lay audience)

TEXT BOOKS

- Davis, Keith, 1984. Human Behaviour at work, New Delhi. Mcgraw Hill.
- Gisbert, Asual S J 1972. Fundamentals of Industrial Sociology, New Delhi, Tata Mc Graw-Hill.
- Ramaswamy, E. A, 1978. Industrial Relations in India. Delhi. MacMillian
- Pascal Gilbert: Fundamental of Industrial Sociology; Orient-Longman.
- E.V.Schneider – Industrial sociology
- Baviskar et al - Social Structure and Change [Vol.IV] Sage Publishers

REFERENCE BOOKS

- Sheth, N R, 1979, Industrial Sociology in India, Jaipur Rawat.
- Dutt and Sundharam 2007. Indian Economy, S Chand Publications. New Delhi: Publications.
- P. Subha Rao: Human Resource Management and Industrial Relations – Himalaya Publishing House

Course Structure of B.Tech. – Mechanical Engineering Specialization in Automobile Engineering Applicable for 2017-2021

Humanities Electives III

Subject Code	HS485	Subject Title	Sustainable Development						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	IV	Semester	VIII

Course Objective

- To provide the overview of sustainable and its needs to the students.
- To provide the importance and components of sustainable development to the students.
- To provide the association of social and economic development to the students.

Unit 1 Overview of Sustainable Development

5 Hrs.

History and emergence of the concept of Sustainable Development, Components of SD i.e. Economic, Social, Human, Institutional, Technological and Environmental development; Definitions, Sustainability in Ecosystem Services; natural resource degradation, greenhouse gases, factors affecting SD (i.e. Industrialization, urbanization, population growth, globalization, etc.)

Unit 2 Policies on Sustainable Development at international level

4Hrs.

Government Policies for SD in India; Socio-economic policies for sustainable development in India, Sustainable development through trade, Carrying Capacity, global policies for sustainable development

Unit 3 Sustainable Development and International Contribution

10 Hrs.

SDGs and MDGs, Complexity of growth and equity, International Summits, Conventions, Agreements, Initiations of international organizations like WHO, UNDP, WTO, FAO and World Bank towards sustainable development

Unit 4 Measurement of Sustainable Development

7Hrs.

Role of developed and developing countries in the sustainable development, Demographic dynamics and sustainability, integrated approach for resource protection and management; Index based estimation of SD i.e. Environmental Sustainable Development Index and sustainable development, and other index

Course Outcome:

- The students will be able to understand the importance of natural resource in economic development.
- The students contribute significant efforts towards sustainable development
- Develop a future-oriented perspective that highlights the significance of their decisions, choices and actions on the quality of life of present and future generations.
- Understand and are empowered to address the real causes and consequences of unsustainable behaviour within the context of an interdependent and globalised world.

TEXT BOOK

The Sustainability Revolution: Portrait of a Paradigm Shift by Edwards, Andres R., New Society Publishers, 2005.

REFERENCE BOOKS

6. The Sustainability Revolution: Portrait of a Paradigm Shift by Edwards, Andres R., New Society Publishers, 2005.
7. Sustainable development in India: Stocktaking in the run up to Rio+20: Report prepared by TERI for MoEF, 2011.

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	CS482	Subject Title	Human Computer Interaction						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4 th	Semester	VIII

Unit 1

(8L)

Introduction: Importance of user Interface–definition, importance of good design. Benefits of good design. A brief history of Screen design. The graphical user interface –popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user –Interface popularity, characteristics- Principles of user interface.

Unit 2

(7L)

Design process–Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions.

Unit 3

(8L)

Screen Designing: Design goals–Screen planning and purpose, organizing screen elements, ordering of screen data and content –screen navigation and flow ,Visually pleasing composition -amount of information -focus and emphasis ,presentation of information simply and meaningfully information retrieval on web - statistical graphics –Technological consideration in interface design.

Unit 4

(8L)

Windows –New and Navigation schemes selection of window, selection of devices based and screen based controls.

Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.

Unit 5

(8L)

Software tools –Specification methods, interface–Building Tools.

Interaction Devices – Keyboard and function keys –pointing devices –speech recognition digitization and generation – image and video displays – drivers.

TEXT BOOKS:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale Human Computer Interaction, 3rd Edition Prentice Hall, 2004.
2. Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, Research Methods in Human Computer Interaction, Wiley, 2010.

REFERENCE:

1. Ben Shneiderman and Catherine Plaisant Designing the User Interface: Strategies for Effective Human-Computer Interaction (5th Edition, pp. 672, ISBN 0-321-53735-1, March 2009), Reading, MA: Addison-Wesley Publishing Co.

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Subject Code	IT357	Subject Title	Internet of Things						
LTP	3 0 0	Credit	3	Subject Category	DE /OE	Year	4 th	Semester	VIII

Course Outline: To provide a detailed idea how the internet is connecting the entire world and helps to live a smart life with its technology.

Course Objective:

1. Vision and Introduction to IoT.
2. Understand IoT Market perspective.
3. Data and Knowledge Management and use of Devices in IoT Technology.
4. Understand State of the Art – IoT Architecture.
5. Real World Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

Course Pre/Co- requisite (if any): Wireless Sensor Networks

Detailed Syllabus

UNIT 1: M2M to IoT(05 Lectures)

The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, use case example, Differing Characteristics.

UNIT 2: M2M to IoT (A Market Perspective)(10 Lectures)

Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

IOT related open source software tools introduction; tools like IoTivity, IBM Blue Mix. Introduction to Contiki, Cooja, Raspberry Pi etc.

UNIT 3:M2M and IoT Technology Fundamentals(05 Lectures)

Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management.

UNIT 4: IoT Architecture-State of the Art(12 Lectures)

Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model

IoT Reference Architecture: Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints- hardware is popular again, Data representation and visualization, Interaction and remote control.

UNIT 5:Industrial Automation(08 Lectures)

Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things

Course Structure of B.Tech. – Mechanical Engineering

Specialization in Automobile Engineering

Applicable for 2017-2021

Commercial Building Automation: Introduction, Case study: phase one-commercial building automation today, Case study: phase two- commercial building automation in the future.

Learning Outcome

- Explain the definition and usage of the term 'The Internet of Things' in different contexts
- Understand where the IoT concept fits within the broader ICT industry and possible future trends
- Able to build and test a complete working IoT system Pursue lifelong learning for professional advancement.

Text book [TB]:

Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.

Reference books [RB]:

1. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.
2. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013

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Subject Code	IT359	Subject Title	Mobile Computing and Services						
LTP	3 0 0	Credit	3	Subject Category	DE /OE	Year	4 th	Semester	VIII

Course Objective:

1. Understand the fundamentals of wireless networks.
2. Understand and evaluate emerging wireless technologies and standards
3. To explore mobile security issues
4. To explore the mobility concept.

Detailed Syllabus

UNIT 1

Introduction: Mobile computing with functions & devices, Networks, Middleware & gateways, Application & services, Developing mobile computing applications, Security & standards why it necessary, Architecture for mobile computing. (3 L)

UNIT 2

Emerging Technologies: Bluetooth, Rfid, WiMAX, Mobile IP, IPv6, GSM architecture, Call routing in GSM, Mobile computing over SMS, Value added service through SMS, GPRS architecture & operations, 3G & applications (10 L)

UNIT 3

Wireless Transmission:

Signal propagation- path loss of radio signals, additional signal propagation effects, Multipath propagation, Multiplexing- Space division, frequency division, time division, code division, Modulation- ASK, FSK, PSK, AFSK, APSK, Multi-carrier modulation
Spread spectrum- Direct sequence & frequency hopping
Mac- Hidden & exposed terminals, near- far terminal, SDMA, TDMA, FDMA, Fixed TDM, CSMA, PRMA, Multiple access with collision avoidance (12 L)

UNIT 4

Wireless LAN: IEEE 802.11 in details, HIPERLAN, Link manager protocol, L2CAP, security, SDP. (5 L)

UNIT 5

Mobility & Security in mobile computing: HTTP,

Wireless application protocol- architecture, wireless datagram protocol, wireless transport layer security, wireless transaction & session protocol, WML, Push architecture, push/ pull services, i-mode & SyncML
Information security, Security techniques & algorithms, public key infrastructure, (10 L)

Learning Outcome

At the end of the course, Learning Outcomes Having successfully completed this course, the student will demonstrate:

- 1: Apply the fundamental design paradigms and technologies to mobile computing applications.

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- 2: Develop consumer and enterprise mobile applications using representative mobile devices and platforms using modern development methodologies.
- 3: Appraise the quality and performance of mobile applications.
- 4: Assess and implement security principles in mobile applications.
- 5: Evaluate wireless network topologies, wireless connectivity and characteristics, and the impact of wireless networks on security and Internet communications.
- 6: Select appropriate wireless technologies in commercial and enterprise applications.

Text book [TB]:

- Jochen H. Schiller: Mobile Communications - Second Edition, Pearson
- Asoke K Talukder & Roopa R Yavagal: Mobile Computing Technology, Applications and Service Creation – Tata McGraw-Hill Publishing Company Limited

Reference books [RB]:

- William Stallings: Wireless Communications & Networks - Second Edition, Pearson
- Theodore S. Rappaport : Wireless Communications Principles & Practice - Second Edition, Pearson

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Applicable for 2017-2021

Subject Code	EC386	Subject Title	Fundamental of Communication & Networks						
LTP	3 0 0	Credit	3	Subject Category	DE /OE	Year	4 th	Semester	VIII

Objectives of the Course:

- To understand the concept of Computer Communication.
- To learn the basics of Data communication and Networks
- To develop and design the protocol systems for advance computer communication.

UNIT I: Introduction to Communication:

Communication system, Analog and Digital Communication, channel bandwidth. Ideal and Practical Filters, Concept of Signal Distortion over a Communication Channel, Energy Signal and Power Signal, Introduction to noise in Communication systems. 6L

UNIT II: Introduction to Modulation techniques:

Concept of Amplitude Modulation, Concept of Frequency & Phase Modulation, Concept of ASK, FSK & PSK, Concepts of PCM. 8L

UNIT III: Introduction to Data Communication Network & OSI Model:

Switching systems, network hardware and software, Layering, design issues for layering, reference models and their comparison, example of networks. Concepts of OSI model. 6L

UNIT IV: Introduction to Data Communication Protocols and transmission media

MAC protocols- Aloha, CSMA, collision free protocols, Ethernet, IEEE 802.3 standard, IP protocols, IP addressing, OSPF, IPv4, IPv6. Transmission media and channel impairments, multiplexing, digital channels, switching. Repeaters, bridges, routers and gateways. 8L

Text Books:

1. Forouzan, B.A., "Data Communication and Networking", 4th Ed., Tata McGraw-Hill.
2. Tanenbaum, A.S., "Computer Networks", 4th Ed., Pearson Education.
3. Stallings W., "Data and Computer Communication", 8th Ed., Prentice-Hall.
4. Simon Haykins, 'Communication Systems', John Wiley, 5th edition

Reference Books:

1. Kurose, J.F. and Ross, K.W., "Computer Networking: A Top-Down Approach Featuring the Internet", 3rd Ed., Addison Wesley.

List of Experiments:

1. To generate amplitude modulated wave and determine the percentage modulation and Demodulate the modulated wave using envelope detector.
2. To generate AM-Double Side Band Suppressed Carrier (DSB-SC) signal.
3. To generate the SSB modulated and Demodulated wave.
4. To generate frequency modulated signal and determine the modulation index and bandwidth for various values of amplitude and frequency of modulating signal and to demodulate a FM signal
5. To study ASK modulation and Demodulation.
6. To study FSK modulation and Demodulation.
7. To study PSK modulation and Demodulation.
8. To Study TDM/PCM Transmitter /Receiver.

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OUTCOMES OF THE COURSE:

The course provides an understanding of:

- Computer Communication and networks.
- Protocol design and their design issues.

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Subject Code	EC382	Subject Title	Biomedical Instrumentation						
LTP	3 0 0	Credit	3	Subject Category	DE /OE	Year	4 th	Semester	VIII

Objectives of the Course: The students will learn

- Requirement of bio-medical and its application
- Concept of bio-potential electrodes and measurements related to them.
- Concepts of bio-transducers and measurements related to them.
- Concept of bio-medical instruments and their uses experimentally.

UNIT I: ANATOMY AND PHYSIOLOGY:

Basic Cell Functions, Origin of Bio-potentials, Electrical Activity of Cells, components of man Instrument system, types of bio-medical stems, design factors and limitations of biomedical instruments, terms and transducers to various physiological events. **8L**

UNIT II: BIO-POTENTIAL ELECTRODE:

Types of bio-potential electrodes., Electrode-Electrolyte interface, half cell potential, Polarization- polarisable and non-polarisable electrodes, Ag/AgCl electrodes, Electrode circuit model; Electrode and Skin interface and motion artifact. Body surface recording electrodes for ECG. Electrodes standards. **8L**

UNIT III: BIO-TRANSDUCER:

Transduction Principles: Resistive Transducers Strain Gauge- types, construction, selection materials, Gauge factor, Bridge circuit, Temperature compensation. Strain Gauge type Blood pressure transducers. Inductive Transducers, Capacitive Transducer, Piezoelectric Transducer. **8**

UNIT IV: BIOTELEMETRY AND ELECTRICAL SAFETY:

Bio-telemetry design, single channel bio telemetry transmitter and receiver system based on AM, FM and, pulse modulation. Significance of Electrical Danger, physiological effect of current, ground shock Hazards. **8L**

Text Books:

1. Joseph J. Carr & John. M. Brown, 'Introduction to Biomedical Equipment technology'
2. R.S. Khandpur, 'Handbook of Biomedical Instrumentation', McGraw Hill.

Reference Books:

- 1 J.G. Webster, 'Medical instrumentation application and design', Houghton Mifflin Co., Boston USA.
- 2 Mohan Murali H, 'Monograph on Biomedical engineering', O.U. Press 1985.
- 3 Geddes L. A. & L. E. Baker, 'Principles of Applied Biomedical Instrumentation', Wiley, 1989.
- 4 Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, 'Biomedical Instrumentations and Measurements' (2nd edition), PHI, 1991.

OUTCOMES OF THE COURSE:

The course provides an understanding of:

- Bio-medical instruments and measurements.
- Principle of working of bio-medical transducers.
- Skills to use modern bio-medical tools and equipment for measurements related to human body.

LIST OF EXPERIMENTS

2. Pulse measurement

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3. Heartbeat measurement
4. Automatic BP measurement
5. Heart sound study using electronics stethoscope
6. ECG measurement

Following experiments to be done on the breadboard

7. Design of low noise and low frequency amplifier for biomedical application
8. Design of Instrumentation amplifier
9. Construction of chopper amplifier

Two Value Added Experiments to be added by Instructor.

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Subject Code	EE485	Subject Title	BASIC INSTRUMENTATION AND PROCESS CONTROL						
LTP	3 0 0	Credit		Subject Category	Open Elective	Year	4th	Semester	VIII

Objectives of the Course

- To make students understand the construction, working principle and application of various transducers used for flow measurement, strain measurement, pressure and vacuum measurement,
- force, torque and power measurement
- To develop an understanding about the different types of telemetry systems used and types of instruments required for display and recording of the data to be transmitted
- Understand about components, characteristics of various control processes used and their modes of operation.

Unit 1	Transducer – I : Definition, advantages of electrical transducers, classification, characteristics, factors affecting the choice of transducers, Potentiometers, Strain gauges, Resistance thermometer, Thermistors, Thermocouples, LVDT, RVDT	8L
Unit 2	Transducer – II: Capacitive, Piezoelectric Hall effect and opto electronic transducers. Measurement of Motion, Force pressure, temperature, flow and liquid level.	8L
Unit 3	Telemetry: General telemetry system, land line & radio frequency telemetering system, transmission channels and media, receiver & transmitter. Data Acquisition System: Analog data acquisition system, Digital data acquisition system, Modern digital data acquisition system.	8L
Unit 4	Telemetry: General telemetry system, land line & radio frequency telemetering system, transmission channels and media, receiver & transmitter. Data Acquisition System: Analog data acquisition system, Digital data acquisition system, Modern digital data acquisition system. Display Devices and Recorders: Display devices, storage oscilloscope, spectrum analyser, strip chart & x-y recorders, magnetic tape & digital tape recorders.	8L
Unit 5	Process Control: Principle, elements of process control system, process characteristics, proportional (P), integral (I), Derivative (D), PI, PD and PID control modes. Electronic, Pneumatic & digital controllers.	8L

Text Books:

- A.K.Sawhney, “Advanced Measurements & Instrumentation”, Dhanpat Rai & Sons
- B.C. Nakra&K.Chaudhry, “Instrumentation, Measurement and Analysis”, Tata Mc Graw Hill 2nd Edition.
- Curtis Johns, “Process Control Instrumentation Technology”, Prentice Hall

Reference Books

- E.O. Decblin, “Measurement System – Application & design”, Mc Graw Hill.
- W.D. Cooper and A.P. Beltried, “Electronics Instrumentation and Measurement Techniques” Prentice Hall International
- RajendraPrasad,”Electronic Measurement and Instrumentation Khanna Publisher
- M.M.S. Anand, “Electronic Instruments and Instrumentation Technology” PHI Learning.

Outcome of the Course:

- Identify the appropriate instruments for measurement of different quantities.
- Ability to analyze, formulate and select suitable sensor for the given industrial applications
- Ability to analyze various control processes used and their modes of operation.

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Subject Code	CE483	Subject Title	GIS						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4th	Semester	VIII

Course Objective: The course provides wide knowledge about basics of GIS and its applications in various fields

Unit-1: Introduction

8L

Definition of GIS, Cartography and GIS, GIS database: spatial and attribute data; Spatial models: Semantics, spatial information, temporal information, conceptual models of spatial information, representation of geographic information: point, line and area features, topology,

Unit-2: Components

12L

Raster and vector data, raster to vector data conversion, map projection, analytical transformation, rubber sheet transformation, manual digitizing and semi-automatic line following digitizer; Remote sensing data as an input to GIS data;

Unit-3: Classifications and Functions

10L

Attribute database: scale and source of inaccuracy; GIS functionality; data storage and data retrieval through query, generalization, classification, containment search within a spatial region;

Unit-4: Analysis

5L

Overlay: arithmetical, logical and conditional overlay, buffers, inter visibility, aggregation; Network analysis;

Unit-5: Applications

4L

Applications of GIS in planning and management of utility lines and in the field of environmental engineering, geotechnical engineering, transportation engineering and water resources engineering.

Course Outcome: The students will learn from this course:

- Basic understanding of GIS concepts, components.
- Analyzing geo-spatial data with various techniques and GIS tools
- Apply the concepts in solving environmental and engineering problems
- Create new information and theoretical knowledge after applying GIS tools

Books Recommended:

1. Geographic Information Systems: A Management Perspective, by Stan Arnoff, WDL Publications.
2. Fundamentals of Spatial Information Systems by Robert Laurini and Derek Thompson, Academic Press.
3. Geographical Information Systems, Vol. I and II edited by Paul Longley, M.F. Goodchild, et.al, John Wiley and Sons, Inc. 1999

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Subject Code	PE491	Subject Title	Carbon Capture and Sequestration Technology						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4 th	Semester	VIII

1. Course Summary

The course provides information about the students to learn the basic concept and Applications of Carbon capture and storage process. In this course, students will learn about carbon capture techniques and the concept of the contribution of fossil fuel to climate change. During this course students will examine the Co₂ emission and Carbon dioxide recycling.

2. Course Objectives

The students should be able to:

1. The objective of this course is make students familiar with the principles and applications of carbon capture and storage capture techniques and role of CCS.

3. Course Outcomes

1. To acquaint the students substantially to the objectives and necessity of Carbon Sequestration and capture.
2. To introduce the contribution of fossil fuel to climate change.
3. To understand the concept of emission and recycling of CO₂.
4. To introduce the candidates to the concept of underground storage and other Carbon Capture and sequestration concepts.
5. To understand the implementation of CCS technology and IPCC.

4. Curriculum Content

UNIT 1

Introduction: Scope, Objectives and Necessity of CCS.

UNIT 2

The contribution of fossil fuels emission to Climate change and global warming. Concept of Carbon Credit and carbon footprint.

UNIT 3

Carbon capture techniques: Carbon-di-oxide emission, Scrubbing of CO₂, Carbon dioxide recycling.

UNIT 4

Carbon dioxide sequestration: Underground storage, Potential for Geologic Storage, Application in Oil and gas industry, Carbon di oxide flooding projects, Methane recovery projects.

UNIT 5

Strategy for implementing CCS technology: Modelling of Cost and Performance of CCS Plants. Role and function of IPCC.

Text book [TB]:

1. Carbon Capture; Jennifer Wilcox; Springer
2. Capturing Carbon – The new weapon in the War Against Climate Change; Mills, Robin M.; Columbia University Press

Reference books [RB]:

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1. Piping and pipeline engineering, George A. Antaki, Marcel Dekker Inc. New York.
2. Fundamentals of pipeline engineering by J. Vincent Genod, Technip Editions

5. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

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Subject Code	MA452	Subject Title	Optimization Techniques						
LTP	3 0 0	Credit	3	Subject Category	Open Elective	Year	4 th	Semester	VIII

Unit 1: Introduction to optimization, Statement and classification of optimization problem, Multi-objective optimization, Multi-variable optimization problem with equality and inequality constraints, Classical optimization techniques, Single variable and multivariable optimization problems, Operation Research approach, general methods for Operation Research models, methodology and advantages of Operation Research.

Unit 2: Introduction to LPP and formulation of Linear Programming problems, Graphical solution method, alternative or multiple optimal solutions, Unbounded solutions, Infeasible solutions, Maximization – Simplex Algorithm, Minimization – Simplex Algorithm using Big-M method, Two phase method, Duality in linear programming.

Unit 3: Introduction to Transportation problems, various methods of Transportation problem, Variations in Transportation problem, introduction to Assignment problems, variations in Assignment problems. Sequential optimization, Representation of multistage decision process; Types of multi stage decision problems; Concept of sub optimization and the principle of optimality.

Unit 4: Optimization techniques, Memetic algorithm, Differential evolution, Evolutionary algorithms, Dynamic relaxation, Genetic algorithms, Hill climbing with random restart, Genetic Algorithm (GA), Artificial Bee Colony (ABC), Particle Swarm Optimization (PSO), Firefly algorithm, Fish School Search, Fly algorithm, Ant colony optimization algorithms

References:

1. S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International P) Ltd., New Delhi, 2000.
2. G. Hadley, "Linear programming", Narosa Publishing House, New Delhi, 1990.
3. H.A. Taha, "Operations Research: An Introduction", 5th Edition, Macmillan, New York, 1992.
4. K. Deb, "Optimization for Engineering Design- Algorithms and Examples", Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.
5. S.D. Sharma, "Operations Research", Kedar Nath Ram Nath Publishers, 2009.

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Code	AR-485	Subject Title	ART APPRECIATION						
LTP	3 0 0	Credit	3	Subject Category	OE	Year	4 th	Semester	VIII

Course Objective:

To create an overview and understanding of various art forms that exists from ancient to modern times.

Unit 1: INTRODUCTION

Understanding various art forms in society and in different cultures.

Unit 2: Sociological Perspective

Relationship between art, culture and society. Influence of art forms on people.

Unit 3: Appreciation-I: Painting/ Sculptures

Understanding and appreciating films/ documentaries from past to present times and between east and west

Unit 4: Appreciation-II: Films/ Documentaries

Understanding and appreciating painting and sculptures from past to present times and between east and west

Unit 5: Appreciation-III: Indigenous/ Folk Art

Understanding and appreciating Indigenous/ Folk art from past to present times and between east and west.

LEARNING OUTCOME:

4. The student will be able to understand the various art forms.
5. The students will be able to understand and establish a relationship between art, culture and society.
6. The students will be able to appreciate the various art.

Text Books:

3. Creative Authenticity: 16 Principles to Clarify and Deepen Your Artistic Vision, Ian Roberts

Reference Books:

The Writer: A Concise Complete and Practical Text Book of Rhetoric. Designed to Aid in The Appreciation, George Lansing Raymond

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Code	PY481	Subject Title	Nano scale science and technology						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4 th	Semester	VIII

Unit 1 (10L)

Introduction to nanotechnology, definition, history of nanotechnology, nanotechnology in relation to other branches of engineering, characteristic length scale of materials and their properties, classification of nano materials, dimensionality and size dependent phenomena, confinement in 0-D, 1-D, 2-D and 3-D, surface to volume ratio, fraction of surface atoms, surface energy.

Unit 2 (7L)

Nanomaterials synthesis techniques; top-down and bottom-up techniques, ball milling, PVD, CVD, self-assembly.

Unit 3 (8L)

Nanomaterials characterization; XRD, SEM, TEM, AFM, UV-VIS.

Unit 4 (8L)

Nanomaterials and their properties: carbon based nano materials, metal based nano materials, quantum dots, biological nano materials.

Unit 5 (7L)

Applications of nanotechnology in engineering, solar energy conversion, nanomedicine.

Text Books:

1. Poole, Jr. CP and Owens, FJ, "Introduction to Nanotechnology", Wiley India. 2006.
2. Cao, G., Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Imperial College Press (2004).
3. Edward L. Wolf: Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience, 2nd ed., Wiley-VCH, 2006.