BACHELOR OF TECHNOLOGY
CURRICULA & SYLLABI

DEPARTMENT OF MECHANICAL ENGINEERING

Baba Sahab Dr. Bhim Rao Ambedkar
College of Agril Engg & Technology - Etawah-206001 (UP)
(Chandra Shekhar Azad University of Agriculture & Technology, Kanpur)

(For newly admitted students from Session 2018-2019)

Mechanical Engineering Department

ABOUT THE DEPARTMENT

The Department of Mechanical Engineering, established in the year 2003, is imparting quality education to the students in the field of Mechanical Engineering through its Undergraduate programme. The department has, over the years, established its reputation as an excellent center for imparting high quality technical education to B Tech students. Presently, the Department is also running M Tech programme in Mechanical Engineering since 2017 under Self Finance scheme of University.

The department has been under Self Finance programme with the support of the core faculty of Agricultural Engineering and its staff. The good numbers of alumni of the department are occupying high positions in Governments, Semi- Governments and Private organizations in the country as well as abroad. The laboratories of the department are being updated from time to time so that they remain well equipped to cater to the Research and Development.

VISION

To become an Acclaimed Department of Higher Learning, Research, Innovation and Incubation in Mechanical Engineering.

MISSION

1. To provide quality education to the students in order to make them globally competitive Mechanical Engineers.
2. To enhance the skills of students using modern engineering tools and experimental techniques to solve real life mechanical engineering problems.
3. To make them work in groups with high level of societal, environmental and professional ethics with the self learning attitude.
4. To establish linkages with the Industries, R&D organizations and Educational institutions in India and abroad for excellence in teaching, research and innovation.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO) OF B. TECH. PROGRAMME

PEO-1. To prepare students in the area of mechanical engineering for successful careers in industries, academia and research organizations through state of the art education.

PEO-2. To provide students with a sound foundation in science and engineering fundamentals necessary to formulate, analyze and solve mechanical engineering problems and to prepare them for research activities.

PEO-3. To develop ability in the field of machine design, thermal engineering, manufacturing and industrial engineering so as to design and create novel products, processes and solutions for the real life problems.

PEO-4. To inculcate in students professional and ethical attitude, effective communication & teamwork skills and ability to apply multidisciplinary knowledge to relate mechanical engineering problems to broader environmental and social context.

PEO-5. To engage students in professional development through the self learning and keep abreast with the state-of-the-art technology needed for a successful professional career.

PROGRAM OUTCOMES (POs) of B.Tech. PROGRAMME:

B. Tech. Mechanical Engineering students will demonstrate the ability to:

PO-1. Apply knowledge of mathematics, science and mechanical engineering fundamentals to solve real life problems.

PO-2. Identify, formulate, apply engineering knowledge, and conduct research to solve real life mechanical engineering problems.

PO-3. Ability to design a system, component or process by applying the knowledge of Machine Design, Thermal Engineering, Manufacturing to meet desired needs within realistic constraints such as economic, environment, cultural, societal, health and safety and sustainability.

PO-4. Ability to design and conduct experiments, as well as to analyze and interpret data and synthesis of information to reach out to solutions.

PO-5. Select, create and apply modern engineering and IT tools, including CAD, CAM to solve complex engineering problems.

PO-6. Apply reasoning to assess the impact of engineering solutions and practices in a global, societal, health, safety, legal and cultural context.

PO-7. Understand the impact of engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

PO-8. Apply ethical principle, inculcate moral values and commit to professional ethics, responsibility and norms of engineering practice.

PO-9. Function effectively as member or leader in diverse teams and in multi-disciplinary settings.

PO-10. Communicate effectively on complex engineering activities with engineering fraternity and society at large such as being able to understand and write effective reports, documents, presentations and give and take instructions clearly.

PO-11. Apply knowledge and understanding of industrial engineering and management principles and function in multidisciplinary teams as a member or leader to manage projects.

PO-12. Recognition of the need for and an ability to engage in life-long self learning in state of the art technology.

PO-13. Ability to apply engineering fundamentals to design mechanical systems, thermal systems and manufacturing processes that leads to efficient production.

Credit Structure for B. Tech. Mechanical Engineering (ME)

(For newly admitted students from Session 2018-2019)

Category **Semesters**	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**
Basic Sciences & Maths (BSM)	14	9	9	5	-	-	-	-	**37**
Management (M)	-	-	-	3	3	-	-	-	**6**
Humanities & Social Science Core (HSSC)	-	4	-	-	-	-	-	-	**4**
Humanities & Social Science Electives (HSSE)	3	-	-	-	-	-	-	-	**3**
Engineering Fundamentals (EF)	7	12	6	2	-	-	-	-	**27**
Department Core (DC)	-	-	8	14	20	22	10	5	**79**
Project (P)	-	-	-	-	-	-	5	5	**10**
Programme Electives (PE)	-	-	-	-	-	-	8	8	**16**
Open Electives (OE)	-	-	-	-	-	-	-	4	**4**
Total	**24**	**25**	**23**	**24**	**23**	**22**	**23**	**22**	**186**

Curriculum for B. Tech. (Mechanical Engineering)

Year-I

Semester-I

S.N.	**Category**	**Paper Code**	**Course**	**L**	**T**	**P**	**Credit**
1.	BSM	BSH-111	Engineering Mathematics-I	3	1	0	4
2.	BSM	BSH-112	Engineering Physics-I	3	1	2	5
3.	HSSE	BSH-***	Humanities & Social Science Electives	2	1	0	3
4.	BSM	BSH-116	Engineering Chemistry	3	1	2	5
5.	EF	MEE-111	Engineering Mechanics	3	1	2	5
6.	EF	CEE-111	Engineering Graphics	0	0	4	2
7.	AC		Audit Course				**4 (NC)**
			Total	**14**	**5**	**10**	**24**

N.B.: Opt one HSSE course (BSH-***) and one Audit course (Non Credit) from the list ahead.

Semester-II

S.N.	**Category**	**Paper Code**	**Course**	**L**	**T**	**P**	**Credit**
1.	BSM	BSH-121	Engineering Mathematics-II	3	1	0	4
2.	BSM	BSH-122	Engineering Physics-II	3	1	2	5
3.	HSSC	BSH-123	Professional Communication	3	1	0	4
4.	EF	EEE-121	Principles of Electrical Engineering	3	1	2	5
5.	EF	CSE-121	Introduction to Computer Programming	3	1	2	5
6.	EF	MEE-121	Workshop Technology	0	0	4	2
7.	AC		Audit Course				**4 (NC)**
			Total	**15**	**5**	**10**	**25**

N.B.: Opt one Audit course (Non Credit) from the list ahead.

Year-II

Semester-III

S.N.	Category	Paper Code	Course	L	T	P	Credits
1.	BSM	BSH-231	Engineering Mathematics-III	3	1	0	4
2.	BSM	MEE-231	Material Science and Engineering	3	1	2	5
3.	EF	MEE-232	Engineering Thermodynamics	3	1	0	4
4.	DC	MEE-233	Measurement & Metrology	2	1	2	4
5.	DC	MEE-234	Mechanics of Solids	3	1	0	4
6.	EF	MEE-235	Mechanical Engineering Drawing	0	0	4	2
7.	AC		Audit Course				**4 (NC)**
			Total	**14**	**5**	**8**	**23**

N.B.: Opt one Audit course (Non Credit) from the list ahead.

Semester-IV

S.N.	Category	Paper Code	Course	L	T	P	Credits
1.	BSM	BSH-241	Numerical Methods	3	1	2	5
2.	M	BSH-242	Industrial Management	2	1	0	3
3.	EF	BSH-243	Communication Skills	0	0	4	2
4.	DC	MEE-241	Fluid Mechanics	3	1	2	5
5.	DC	MEE-242	Kinematics of Machines	3	1	0	4
6.	DC	MEE-243	Energy Conversion Systems	3	1	2	5
7.	AC		Audit Course				**4 (NC)**
			Total	**14**	**5**	**10**	**24**

N.B.: Opt one Audit course (Non Credit) from the list ahead.

Year-III

Semester-V

S.N.	Category	Paper Code	Course	L	T	P	Credits
1.	M	BSH-351	Engineering and Managerial Economics	2	1	0	3
2.	DC	MEE-351	Machine Design-I	3	1	2	5
3.	DC	MEE-352	Heat and Mass Transfer	3	1	2	5
4.	DC	MEE-353	Dynamics of Machines	3	1	2	5
5.	DC	MEE-354	Manufacturing Science	3	1	2	5
6.	AC		Audit Course				**4 (NC)**
			Total	**14**	**5**	**8**	**23**

N.B.: Opt one Audit course (Non Credit) from the list ahead.

Semester-VI

S.N.	Category	Paper Code	Course	L	T	P	Credits
1.	DC	MEE-361	Machine Design-II	3	1	2	5
2.	DC	MEE-362	Refrigeration & Air conditioning	3	1	2	5
3.	DC	MEE-363	I C Engines	3	1	0	4
4.	DC	MEE-364	Machine Tools & Machining	3	1	0	4
5.	DC	MEE-365	Principles of Industrial Engineering	3	1	0	4
6.	AC	MEE-366	Seminar	0	0	6	6 **(NC)**
			Total	**15**	**5**	**4**	**22**

Year-IV

Semester-VII

S.N.	Category	Paper Code	Course	L	T	P	Credit
1.	DC	MEE-471	Automobile Engineering	3	1	2	5
2.	DC	MEE-472	Computer Aided Design	3	1	2	5
3.	PE1	MPE-***	Program Elective-1	3	1	0	4
4.	PE2	MPE-***	Program Elective-2	3	1	0	4
5.	P	MEE-473	Project Part-I	0	0	10	5
6.	AC	MEE-474	Industrial/Practical Training	0	0	2	2 **(NC)**
			Total	**12**	**4**	**14**	**23**

N.B.: 1. Opt one program elective each from the list of Program Elective 1&2 (MPE-***) attached ahead

2. Industrial/ Practical Training shall be offered at the end of Sixth Semester & evaluation in Seventh Semester.

Semester-VIII

S.N.	Category	Paper Code	Course	L	T	P	Credit
1.	DC	MEE-481	Computer Aided Manufacturing	3	1	2	5
2.	PE3	MPE-***	Program Elective-3	3	1	0	4
3.	PE4	MPE-***	Program Elective-4	3	1	0	4
4.	OE	AOE-***/ COE-***/ EOE-***/ BOE-***	Open Elective offered by other Department	3	1	0	4
5.	P	MEE-482	Project Part-II	0	0	10	5
			Total	**12**	**4**	**12**	**22**

N.B.: Opt one program elective each from the list of Program Electives – 3 & 4 (MPE-***); and one open elective from list of Open Elective (AOE-***/COE-***/ EOE-***/BOE-***) attached ahead.

Humanities & Social Science Electives (Mechanical Engineering)

S.N.	Paper Code	Course	Prerequisite Course	L	T	P	Credits
1.	BSH-113	Human Values & Professional Ethics	-	2	1	0	3
2.	BSH-114	Industrial Psychology	-	2	1	0	3
3.	BSH-115	Industrial Sociology	-	2	1	0	3

Audit Courses for B. Tech. (Mechanical Engineering)

S.N.	Paper Code	Course	Prerequisite Course	L	T	P	Credits
		Year-I (I & II Semester)					
1.	BSH-117	Environmental Chemistry	-	3	1	0	4
2.	BSH-118	Environment & Ecology	-	3	1	0	4
3.	ECE-121	Fundamentals of Electronics Engineering	-	3	0	2	4
4.	BSH-124	Space Sciences	-	3	1	0	4
		Year-II (III & IV Semester)					
5.	BSH-232	Nano Technology	-	3	1	0	4
6.	EEE-231	Electromechanical Energy Conversion	-	3	0	2	4

7.	EEE-232	Introduction to Microprocessors	-	3	0	2	4
8.	SWE-241	Information Technology for land & water Management		3	-	2	4
9.	FPE-241	Waste & Bi-products utilization		3	-	2	4
10.	REE-241	Bio-Energy Systems: Design and Applications		3	-	2	4
		Year-III (V Semester)					
11.	CSE-351	Neural Network & Fuzzy Systems	-	3	1	0	4
12.	CSE-352	Database Management Systems	-	3	0	2	4
13.	CEE-351	Environmental Impact Assessment & Management	-	3	1	0	4

Engineering Fundamentals & Department Core (Mechanical Engineering)

S.N.	Paper Code	Course	Prerequisite Courses	L	T	P	Credits
		Year-I					
1.	MEE-111	Engineering Mechanics	-	3	1	2	5
2.	MEE-121	Workshop Technology	-	0	0	4	2
		Year-II					
3.	MEE-231	Material Science and Engineering	-	3	1	2	5
4.	MEE-232	Engineering Thermodynamics	-	3	1	0	4
5.	MEE-233	Measurement & Metrology	-	2	1	2	5
6.	MEE-234	Mechanics of Solids	-	3	1	2	5
7.	MEE-235	Mechanical Engineering Drawing	-	0	0	4	2
8.	MEE-241	Fluid Mechanics	-	3	1	2	5
9.	MEE-242	Kinematics of Machines	-	3	1	0	4
10.	MEE-243	Energy Conversion Systems	-	3	1	2	5
		Year-III					
11.	MEE-351	Machine Design-I	MEE-234	3	1	2	5
12.	MEE-352	Heat and Mass Transfer	MEE-232	3	1	2	5
13.	MEE-353	Dynamics of Machines	-	3	1	2	5
14.	MEE-354	Manufacturing Science	-	3	1	2	5
15.	MEE-361	Machine Design-II	MEE-234	3	1	2	5
16.	MEE-362	Refrigeration & Air conditioning	-	3	1	2	5
17.	MEE-363	I C Engines	-	3	1	0	4
18.	MEE-364	Machine Tools & Machining	-	3	1	0	4
19.	MEE-365	Principles of Industrial Engineering	-	3	1	0	4
20.	MEE-366	Seminar	-	0	0	6	3
		Year-IV					
21.	MEE-471	Automobile Engineering	MEE-363	3	1	2	5
22.	MEE-472	Computer Aided Design	-	3	1	2	5
23.	MEE-473	Project Part-I	-	0	0	10	5
24.	MEE-474	Industrial/Practical Training	-	0	0	2	1
25.	MEE-481	Computer Aided Manufacturing	-	3	1	2	5
26.	MEE-482	Project Part-II	MEE-473	0	0	10	5

Programme Electives (Mechanical Engineering)

S.N.	Paper Code	Course	Prerequisite Courses	L	T	P	Credits
		PE1 & PE2 (VII Semester)					
1.	MPE-471	Hydraulic Machines	MEE-241	3	1	0	4
2.	MPE-472	Principles of Machine Tools Design	-	3	1	0	4
3.	MPE-473	Production Planning & Control	-	3	1	0	4
4.	MPE-474	Industrial Tribology	-	3	1	0	4
5.	MPE-475	Total Quality Management	-	3	1	0	4
6.	MPE-476	Energy Management	-	3	1	0	4
7.	MPE-477	Mechanical Vibrations	-	3	1	0	4
8.	MPE-478	Renewable Energy systems	-	3	1	0	4
		PE3 & PE4 (VIII Semester)					
1.	MPE-481	Power Plant Technologies	MEE-232	3	1	0	4
2.	MPE-482	Turbo Machinery	MEE-232	3	1	0	4
3.	MPE-483	Project Management	-	3	1	0	4
4.	MPE-484	Advanced Welding Technology	-	3	1	0	4
5.	MPE-485	Advanced Manufacturing Technology	-	3	1	0	4
6.	MPE-486	Advanced Engineering Materials	-	3	1	0	4
7.	MPE-487	Advanced Mechanics of Solids	MEE-234	3	1	0	4
8.	MPE-488	Gas Dynamics and Propulsion	-	3	1	0	4

Courses offered to other departments

S.N.	Paper Code	Course	Prerequisite Course	L	T	P	Credits
1.	MOE-481	Fundamentals of Mechanical Engineering	-	3	1	0	4
2.	MOE-482	Manufacturing Processes	-	3	1	0	4
3.	MOE-483	Engineering Materials	-	3	1	0	4

Open Elective Courses

S.N. Paper	Code	Course	L	T	P	Credits
1.	MOE-481	Fundamentals Of Mechanical Engineering	3	1	0	4
2.	MOE-482	Manufacturing Processes	3	1	0	4
3.	MOE-483	Engineering Material	3	1	0	4
4.	AOE-481	Photovoltaic Technology And Systems	3	0	2	4
5.	AOE-482	Remote Sensing And GIS Applications	3	0	2	4
6.	AOE-483	Human Engineering And Safety	3	0	2	4
7.	COE-481	Database Management System, Data Mining & Warehousing	3	1	0	4
8.	COE-482	Object Oriented Techniques & Java Programming	3	1	0	4
9.	COE-483	Introduction to Web Technology	3	1	0	4
10.	EOE-481	Non-Conventional Energy Resources	3	1	0	4
11.	EOE-482	Industrial Electronics	3	1	0	4
12.	EOE-483	Development Product	3	1	0	4
13.	BOE-481	Entrepreneurship Development	3	1	0	4
14.	BOE-482	Enterprise Resource Planning	3	1	0	4
15.	BOE-483	E-Commerce & IT	3	1	0	4

Course offered by Basic Sciences, Maths & Humanities (BSH)

SYLLABI

BSH-111 ENGINEERING MATHEMATICS-I

Course category	:	Basic Sciences & Maths (BSM)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Use of basic differential operators in various engineering problems.
2. Solve linear system of equations using matrix algebra.
3. Use vectors to solve problems involving force, velocity, work and real life problems and able to analyze vectors in space
4. Evaluate and use double integral to find area of a plane region and us of triple integral to find the volume of region in 3^{rd} dimension

Topics Covered

UNIT-I

Differential Calculus: Leibnitz theorem, Partial derivatives, Euler's theorem for homogenous function, Total derivative, Change of variable. Taylor's and Maclaurin's theorem. Expansion of function of two variables, Jacobian, Extrema of function of several variables. 9

UNIT-II

Linear Algebra: Rank of Matrix, Inverse of a Matrix, Elementary transformation, Consistency of linear system of equations and their solution. Characteristic equation, Eigen-values, Eigen-vectors, Cayley-Hamilton theorem. 9

UNIT-III

Multiple Integrals: Double and triple integrals, change of order of integration, change of variables. Application of multiple integral to surface area and volume. Beta and Gamma functions, Dirichlet integral. 9

UNIT-IV

Vector Calculus: Gradient, Divergence and Curl. Directional derivatives, line, surface and volume integrals. Applications of Green's, Stoke's and Gauss divergence theorems (without Proofs). 9

Books & References

1. B.S. Grewal: Higher Engineering Mathematics; Khanna Publishers.
2. B.V. Ramana: Higher Engineering Mathematics, Tata McGraw Hill Education Pvt. Ltd., New Delhi.

3. H.K. Dass and Rama Verma: Engineering Mathematics; S. Chand Publications.
4. N.P. Bali and Manish Goel: Engineering Mathematics; Laxmi Publications.

BSH-112 ENGINEERING PHYSICS-I

Course category	:	Basic Sciences & Maths (BSM)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, practical work, record, viva voce & Practical and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this Course

1. Basics of relativity and its application in Engineering.
2. Quantum Mechanics and its application to understand material properties.
3. Statistical mechanics and its application in study of Macro and Micro scale properties of Matter.
4. Use of the principle of optics in the measurement.
5. Applications of Laser and holography in Engineering.
6. Basic Principles of optical Fibre and its application in Engineering.

Topics Covered

UNIT-I 9

Relativistic Mechanics: Inertial and Non-inertial Frames of reference, Galilean transformation, Michelson-Morley Experiment, Postulates of special theory of relativity, Lorentz Transformation, Length contraction, Evidences of length contraction, Time dilation, Evidences for time dilation, Relativistic velocity transformation, Relativistic variation of mass with velocity, Evidence of mass variation with velocity, Relativistic kinetic energy, Mass energy equivalence, Examples from nuclear physics, Relativistic energy-momentum relation.

UNIT-II 9

Statistical Mechanics: Brief Introduction of Classical Statistics, Bose Einstein Statistics, Application to Black body radiation, distribution law of energy, Planck's radiation formula and Stefan's law. Fermi – Dirac statistics, Application to electrons in metals (energy distribution, Fermi energy).

Quantum Mechanics: De Broglie waves and Group velocity concept, Uncertainty principle and its application, Davisson-Germer experiment, Derivation of Schrodinger equation for time independent and time dependent cases. Postulates of quantum mechanics, Significance of wave function, Application of Schrodinger wave equation for a free particle (one dimensional and three dimensional case), Particle in a box (one dimensional and three dimensional), Simple harmonic oscillator (one dimensional and three dimensional).

UNIT-III 9

Geometrical Optics: General theory of image formation: Cardinal points of an optical system; general relationships, thick lens and lens combinations.

Optical instruments: Need for a multiple lens eyepiece, common type of eyepieces

Physical Optics:

Interference: Interference of light, Interference in thin films (parallel and wedge shaped film), Newton's rings.

Diffraction: Single, double and N- Slit Diffraction, Diffraction grating, Grating spectra, dispersive power, Rayleigh's criterion and resolving power of grating.

Polarization: Phenomena of double refraction, Nicol prism, Production and analysis of plane, circular and elliptical polarized light, Retardation Plate, Polarimeter

UNIT-IV 9

Modern Optics

Laser: Spontaneous and stimulated emission of radiation, population inversion, concept of 3 and 4 level Laser, construction and working of Ruby, He-Ne lasers and laser applications.

Fiber Optics: Fundamental ideas about optical fiber, Propagation mechanism, Acceptance angle and cone, Numerical aperture, Propagation Mechanism and communication in fiber Single and Multi Mode Fibers, step index and graded index fiber, attenuation and losses.

Holography: Basic Principle of Holography, Construction and reconstruction of Image on hologram and applications of holography.

EXPERIMENTS

1. To determine the wavelength of monochromatic light by Newton's Ring
2. To determine the specific rotation of cane sugar solution using polarimeter
3. To determine the wavelength of spectral lines using plane transmission grating.
4. To verify Brewster's law using rotating Nicol prism
5. To verify Stefan's law by electrical method
6. To Study resonance in LCR circuit with a c source.
7. To determine the height of a tower with a Sextant.
8. To determine the refractive index of a liquid by Newton's ring.

Books & References

1. Introduction to Special theory Relativity-Robert Resnick, Wiley Eastern Ltd.
2. Statistical Mechanics and Properties of Matter- E S R Gopal, John Wiley and Sons
3. Quantum Mechanics: Theory and Applications- Ajoy Ghatak, Tata McGraw-Hill
4. Optics- Ajoy Ghatak, Tata McGraw-Hill
5. Optics- N. Subrahmanyam, Brij Lal, M.N. Avadhanulu, S. Chand
6. Fiber optics and laser Principles and Applications-Anuradha De, New Age International
7. Concepts of Modern Physics-Arthur Beiser, Tata McGraw-Hill

BSH-116 ENGINEERING CHEMISTRY

Course category : Basic Sciences & Maths (BSM)
Pre-requisite Course : NIL
Contact hours/week : Lecture : 3, Tutorial : 1 , Practical: 2

Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, practical work, record, viva voce & Practical and theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Students will acquire basic knowledge in Engineering Chemistry, which allows students to gain qualitative and quantitative skills.
2. Make good scientific observations and develop experimental method of evaluation of different systems at industrial or research level.
3. Students will develop Interdisciplinary skills which can help them to thrive in the life- long changing environment in various fields of Industry.
4. Students will acquire practical knowledge and will be able to analyze data constructively and formulate new ideas.

Topics Covered

UNIT-I 9

Molecular orbital theory, LCAO approximation, MO diagrams of diatomic molecules. Band theory of metallic bond, Hydrogen bonding, Structure of graphite and fullerene- C_{60}, Liquid crystallite state, classification and applications of liquid crystals, Types of unit cell, space lattice (only cubes), Bragg's Law, Calculation and density of the cubic unit cell, Phase Rule and its application to water system.

UNIT-II 9

Inductive, mesomeric and hyperconjugative effects, stability of reactive intermediates, e.g. Carbocation, Carbanion and free radicals. Types of organic reactions, mechanism of nucleophilic substitution and elimination reactions. Mechanism of organic name reactions (Cannizzaro reaction, Aldol condensation, Pinacol-pinacolone rearrangement, Beckmann rearrangement, Hoffmann rearrangement & Diels Alder Reaction) Stereoisomerism of organic compounds containing one & two chiral centers. Enantiomers & diastereomers, R-S & E-Z Nomenclature. Examples of optically active compounds without chiral centre. Conformations of butane.

UNIT-III 9

Introduction & classification of polymers, Chain and Step growth polymerization, Thermoplastic and Thermosetting resins, Elastomers and synthetic fibers. Mechanism of chain polymerization, Stereoregular polymers, Synthesis and applications of: Polyethylene, Poly propylene, PVC, PMMA, PAN, PET, Polyamides, Polyurethane, Natural and synthetic Rubbers, Phenol Formaldehyde Resin.

Conducting & biodegradable polymers and their applications. Cement and its applications. Classification of Fuels, calorific value of fuel, gross & net calorific value, determination of calorific value using Bomb calorimeter.

UNIT-IV 9

Basic principles of spectroscopic methods, Basic principles of UV-Visible, IR, ^{1}H NMR & Mass spectroscopy, determination of structure of simple organic compounds. Hardness of water, Softening of water (Zeolite process, Lime Soda process & Ion exchange process). Treatment of boiler feed water by Calgon process.

EXPERIMENTS

1. Determination of iron content in the given sample using $K_3[Fe(CN)_6]$ as an external indicator.
2. Determination of temporary and permanent hardness in water sample using EDTA as standard solution.
3. Determination of alkalinity in the given water sample.
4. Determination of chloride content in the given water sample by Mohr's method.
5. Determination of percentage of available chlorine in bleaching powder sample.
6. pH-metric titration between strong acid and strong base.
7. Viscosity of a polymer like polystyrene by Viscometric method.
8. Element detection & functional group identification in organic compounds
9. Preparation of a polymer like Bakelite or PMMA.
10. Preparation of Sodium Cobaltinitrile salt.

Books & References

1. Engineering Chemistry, Wiley India
2. Engineering Chemistry, Tata McGraw Hill
3. Concise Inorganic Chemistry - J.D. Lee; Wiley India
4. Organic Chemistry- Morrison & Boyd, 6th edition, Pearson Education
5. Physical Chemistry - Gordon M. Barrow; McGraw Hill
6. Physical Chemistry - Peter Atkins & Julio De Paula, Oxford University Press

BSH-121 ENGINEERING MATHEMATICS – II

Course category	:	Basic Sciences & Maths (BSM)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, midterm examination and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Use of various mathematical techniques such as differential operators, matrix algebra and vector differentiation and integration.
2. To identify, formulate and solve the real life problems.
3. To inculcate the habit of mathematical thinking and lifelong learning.

Topics Covered

UNIT-I 9

Differential Equations: Linear differential equations with constant coefficients $(nthorder)$, complementary function and particular integral. Simultaneous linear differential equations, solution of second order differential equations by changing dependent and independent variables, Method of variation of parameters, Applications of differential equations to engineering problems

UNIT-II 9

Special functions: Series solution of second order differential equations with variable coefficient (Frobeneous method). Bessel and Legendre equations and their series solutions, Properties of Bessel function and Legendre polynomials

UNIT-III 9

Laplace Transform: Laplace Transform, Laplace transform of derivatives and integrals. Unit step function, Laplace transform of Periodic function. Inverse Laplace transform, Convolution theorem, Applications to solve simple linear and simultaneous differential equations.

UNIT-IV 9

Fourier Series and Partial Differential Equations: Periodic Functions, Fourier Series of period 2π, Change of interval, Even and Odd functions, Half range Sine and Cosine Series. Harmonic analysis, Partial Differential Equations with constant coefficients

Books & References

1. Higher Engineering Mathematics - B.S. Grewal, Khanna Publishers
2. Engineering Mathematics - H.K. Dass and Rama Verma, S. Chand Publications
3. Engineering Mathematics - N.P. Bali and Manish Goel, Laxmi Publications
4. Higher Engineering Mathematics - B.V. Ramana, Tata McGraw Hill Education Pvt. Ltd., New Delhi

BSH-122 ENGINEERING PHYSICS-II

Course category	:	Basic Sciences & Maths (BSM)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Basics of crystallography application in Engineering
2. Use of the principles of sound wave and acoustics in civil engineering with the consideration of NDT.
3. Basic principles of electricity and magnetism applied in Engineering.
4. Maxwell's equation of electromagnetic theory and its application in engineering.
5. Basic principles of semiconducting materials and its application.
6. Basic Principles of Superconductivity and its application in Engineering.

Topics Covered

UNIT-I 9

Crystal Structures and X-ray Diffraction: Space lattice, basis, Unit cell, Lattice parameter, Seven crystal systems and Fourteen Bravais lattices, Crystal-System Structure, Packing factor (cubic, body and face), Crystal structure of NaCl and diamond, Lattice planes and Miller Indices, Reciprocal Lattice, Diffraction of X-rays by crystal, Laue's experiment, Bragg's Law, Bragg's spectrometer.

UNIT-II 9

Sound Waves and Acoustics: Sound waves, intensity, loudness, reflection of sound, echo; Reverberation, reverberation time, Sabine's formula, remedies over reverberation; Absorption of sound, absorbent materials; Conditions for good acoustics of a building; Noise, its effects and remedies; Ultrasonics –Production of ultrasonics by Piezo-electric and magnetostriction; Detection of ultrasonics; Engineering applications of Ultrasonics (Non-destructive testing).

UNIT-III 9

Electrodynamics –I: Basic concepts of Gauss's law, Ampere's law and faradays law of electromagnetic induction. Correction of Ampere's law by Maxwell (concept of displacement current), Maxwell's equation, transformation from integral form to differential form, physical significance of each equation

Electrodynamics –II: Maxwell's equation in free space, velocity of electromagnetic wave, transverse character of the wave and orthogonality of E, H and k vectors, Maxwell's equations in dielectric medium and velocity of e. m. wave, comparison with free space, Maxwell's equations in conducting media, solution of differential equation in this case and derivation of penetration depth

UNIT-IV 9

Physics of Advanced Materials

Semiconducting Materials: Concept of energy bands in solids, Carrier concentration and conductivity in intrinsic semiconductors and their temperature dependence, carrier concentration and conductivity in extrinsic semiconductors and their temperature dependence. Hall effect in semiconductors, Compound semiconductors, Optoelectronic Materials.

Superconducting Materials: Temperature dependence of resistivity in superconducting materials, Effect of magnetic field (Meissner effect), Temperature dependence of critical field, Type I and Type II superconductors, Electrodynamics of superconductors, BCS theory (Qualitative), High temperature superconductors and Applications of Superconductors.

Nano-Materials: Basic principle of nanoscience and technology, structure, properties and uses of Fullerene and Carbon nanotubes, Applications of nanotechnology.

Books & References

1. Introduction to Solid State Physics- Kittel , 7th edition, Wiley Eastern Ltd.
2. Solid State Physics - S. O. Pillai, 5th edition, New Age International.
3. Introduction to Electrodynamics- David J. Griffiths Pearson, New International Edition
4. Semiconductor Devices and Application - S.M. Sze, Wiley
5. Introduction to Nano Technology - Poole Owens, Wiley India
6. Master Hand book of Acoustics - F. Alton Everest and Ken Pohlmann, 5th edition, McGraw Hill

BSH-123 PROFESSIONAL COMMUNICATION

Course category	:	Humanities & Social Science Core (HSSC)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, midterm examination and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Use of various facets of communication skills, such as, Reading, Writing, Listening and speaking skills.
2. To identify, formulate and solve the real life problems with positive attitude.
3. To inculcate the habit of learning and developing the communication and soft skills by practice.

Topics Covered

9

UNIT-I

Communication

Principles of Communication – Communication as coding and decoding – signs and symbols – verbal and non –verbal symbols – Language AND communication; language VS communication, language as a tool of communication – media/channels for communication **:** Types of Communication- functional, situational, verbal and non-verbal, interpersonal, group, interactive, public, mass line, dyadic – with illustrations LSRW in Communication – Listening – active vs passive (Talk less, listen more); Speaking - Speech vs. enunciation (mind your tone); Reading – Focus on the structure not on the theme alone, Technical Communication, General Communication, Barriers of Communication, Levels of Communication

UNIT-II 9

Language Acquisition through Grammar, Usage and Mechanics of Writing

Vocabulary, Phrase, Clause, Parts of Speech: Types ,Examples with Use Gender, Singular, Plural, Article, Sequence of Tenses, Use of Modifiers, Sentence-Loose Sentence, Periodical Sentence, Topic Sentence, Paragraph-Different Orders and Methods of Paragraph Writing, Inductive Method, Deductive Method, Spatial Method, Question and Answer Method, Chronological Method, Expository Method, Common Errors, Antonyms, Synonyms, One-word Substitutes, Homophone, Homonym, Comprehension and Précis, Words Frequently Misspelt, Punctuation and Capitalization, Abbreviations and Numerals , Proofreading, Using the Library

UNIT-III 9

Technical Writing

Report Writing: Meaning, Types, Structure, Methods and Models of Report Writing, Technical Proposal; Concept, Kinds, Layout, and Examples of Technical Proposal, Definitions, Characteristics, Structure, Letter Writing: Importance, Types, Layout, and examples of letters, Scientific and Technical Writing: Features, Methods, Examples, Project, Thesis and Dissertation Writing

UNIT-IV 9

Spoken and Presentation Skills

Impromptu speech – tackling hesitation, shyness and nervousness in speaking – Public speaking, academic and professional presentations – Group discussions – facilitators and impediments Planning, preparing and delivering a presentation, essentials of presentation - etiquette; clarity; lively delivery – Speech generation; speech rhythm; speech initiators body language – voice, posture and gesture; eye contact; dress codes; verbal crutches; stresses, pronunciation – contextualization – creating and understanding contexts, Speech Drill.

Books & References

1. Complete Course in English - Dixon Robert J., Prentice Hall of India, New Delhi
2. A Practical English Grammar - Thomson and Martinet, ELBS
3. English Pronouncing Dictionary - Jones Daniel, Paperback
4. Spoken English - Bansal ,R.K. &Harrison J.B., Orient Longman, India
5. Handbook of Pronunciation of English Words - Sethi J. & Jindal D.V.A, Prentice Hall of India, New Delhi
6. Word Power Made Easy - Lewis, Norman, Pocket Books
7. Business Correspondence and Report Writing - Sharma R.C. & Mohan Krishna, Tata McGraw Hill
8. Business Communication - Chhabra T.N., Sun India Publication, New Delhi

BSH-231 ENGINEERING MATHEMATICS-III

Course category	:	Basic Sciences & Maths (BSM)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, midterm examination and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Use of Residue theorem and Integral formula to evaluate various integrals.
2. Use of moments and kurtosis to find the type of curve.
3. To interpolate a curve using Gauss, Newton’s interpolation formula.
4. To find the derivative of a curve and area of a curve.

Topics Covered

UNIT-I 9

Functions of Complex Variable: Analytic function, C-R equations, Cauchy-Integral Theorem, Cauchy-Integral formula, Taylor's Series and Laurent Series, Zero's and Singularities, Residue theorem, Evaluation of the real integrals of the type $\int_0^{2\pi} f(\text{Cos}\,\theta, \text{Sin}\,\theta)d\theta$ and $\int_{-\infty}^{+\infty} f(x)dx$

UNIT-II 9

Statistical Techniques: Moments, Generating function for moments, Skewness, Kurtosis, and Curve fitting: Method of Least Squares, Fitting of Straight lines and Parabola. Correlation and Regression. Binomial Distribution, Poisson's Distribution, and Normal Distributions.

UNIT-III 9

Numerical Techniques: Solution of polynomial equations by Bisection, Regula-Falsi and Newton- Raphson's methods. Interpolation: Newton's forward and backward interpolation formulae, Lagrange's and Newton's divided difference methods for unequal intervals.

UNIT-IV 9

Solution of Linear and Differential equations and Numerical Integration: Solution of linear equations by Crout's method and Guass-Siedel method. Solution of ordinary Differential equations by Euler's, Picard's and Fourth order Runge-Kutta methods. Numerical Integration by Trapezoidal, Simpson's one-third and Simpson's three-eight rules.

Books & References

1. B.S. Grewal - Higher Engineering Mathematics; Khanna Publishers.
2. B.V. Ramana - Higher Engineering Mathematics, Tata McGraw Hill Education Pvt. Ltd., New Delhi
3. H.K. Dass and Rama Verma - Engineering Mathematics; S. Chand Publications
4. N.P. Bali and Manish Goel - Engineering Mathematics; Laxmi Publications

BSH-241 NUMERICAL METHODS

Course category	:	Basic Sciences & Maths (BSM)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, midterm examination and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To find the root of a function using Bisection, Regula falsi, Newton's Method, Aitken's method.
2. To interpolate a curve using Gauss, Newton's interpolation formula.
3. To solve the first order boundary value problem.

Topics Covered

UNIT-I 9

Roots of equation: Bisection method, Regula Falsi Method, Secant Method, Fixed point Iteration Method, Newton Raphson Method, Modified Newton Raphson Method for Multiple roots, derivation of rate of convergence, Aitken Method.

UNIT-II 9

Solutions of system of Linear equations and Eigen Value problem: Linear equations: Direct method for solving systems of linear equations (Gauss elimination, Gauss Jordan, LU Decomposition, Cholesky Decomposition), Iterative methods (Jacobi, Gauss Seidel, Relaxation method). Algebraic Eigen value problem: Power method, Jacobi's method, Given's method.

UNIT-III 9

Numerical Quadrature: Relationship in various difference operators, Newton Gauss Forward a nd Backward Interpolation, Lagrange and Newton divided difference interpolation, Newton Cotes Formula, trapezoidal Rule, Simpson's 1/3 and 3/8 rule, Gauss Quadrature Formula, Chebyehev's Formula, Piecewise Linear Interpolation, Cubic Spline Interpolation.

UNIT-IV 9

Numerical solution of Ordinary differential equations and, Difference Equation: Single Step Methods: Taylor, Picard, Euler, Runge-Kutta Fourth Order Methods. Multistep methods: Milne's and Adam's predictor and corrector methods. Difference equations and their solutions, Rules for finding the particular integral.

EXPERIMENTS

1. To implement Regula-Falsi method to find root of algebraic equation.
2. To implement Newton-Raphson method to find root of algebraic equation.
3. To implement Newton's Divided Difference formula to find value of a function at a point.
4. To implement Numerical Integration by using Simpson's one-third rule.
5. To implement numerical solution of differential equation by Picard's method.
6. To implement numerical solution of differential equation by using Euler's method.
7. To implement numerical solution of differential equation by using Runge – Kutta Method.

Books & References

1. Numerical Methods: M.K. Jain, S.R.K. Iyenger and R.K. Jain, New Age Publishers.
2. Numerical Methods: P. Kandasamy, K.Thilagavathi, K.Gunavathi., S. Chand & Company.
3. Dr. B.S. Grewal; Higher Engineering Mathematics, Khanna Publishers, Delhi.
4. B.V. Ramana; Higher Engineering Mathematics, Tata Mc. Graw Hill Education Pvt. Ltd., New Delhi.

BSH-242 INDUSTRIAL MANAGEMENT

Course category	:	Management (M)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 2, Tutorial : 1 , Practical: 0
Number of Credits	:	3
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, midterm examination and Theory Examination

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Student will become efficient and acquire acumen of more profitable business practices
2. Students will understand importance of better customer service and product quality
3. Able to make work safer, faster, easier, and more rewarding
4. Able to help industry in production of more products which posses all utility factors
5. Making the world safer through better designed products and processes
6. Reducing costs associated with new technologies

Topics Covered

UNIT-I 6

Introduction: Management and Industrial Engineering and relation with other fields, Management concepts.

Plant Location and Layout: General considerations, Types of Layout, Cellular Manufacturing.

UNIT-II 6

Work Analysis and Measurement: Design of work methods, Time and motion study, Work sampling, Selection of labour and wage payment, Incentive and motivation.

Functional Management: Sources of finance, Balance sheet and Income statement, Different element of costs, Depreciation, Break-even analysis, Economic appraisal of projects.

UNIT-III 6

Production Planning and Control: Methodology, Aggregate Planning, Scheduling, Line of Balancing.

Quality Control: Concepts of quality, Acceptance sampling, Control Charts, Total Quality Management.

UNIT-IV 6

Material Management: Inventory management, Deterministic and probabilistic models of Inventory control, Material requirements Planning, JIT, ERP, SCM Business process reengineering. **Project Management**: CPM and PERT, Cost consideration and Crashing

Books & References

1. Joel Dean. Managerial Economics, PHI Ltd., New Delhi.
2. P. Crowson. Economics for Managers, Macmillan, London.
3. Prasanna Chandra.. Financial Management, TMH Pvt. Ltd., New Delhi.

BSH-243 COMMUNICAION SKILLS

Course category : Humanities & Social Sciences (HSS)
Pre-requisite Course : NIL
Contact hours/week : Lecture : 0, Tutorial : 0 , Practical: 4
Number of Credits : 2
Course Assessment methods : Continuous assessment through Viva voce, Practical work/record, attendance and Major Practical Examination

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Overcome the problems he/she faces in oral and written communication.
2. Acquire knowledge of and methods for using technical communication such as reports, proposals and business letters, etc.
3. Use and practice compositions correctly.
4. Give Presentations in different sessions and make self appraisal.

Topics Covered

UNIT-I 12

Software to be used: Learn to Speak English and Present individually and in group Introduction to vowel and consonant sounds; introduction to syllable stress; noun stress; voiced and voiceless sounds; diphthongs; rate of speech.

UNIT-II 12

Fluency Building – word match, reading aloud, recognition of attributes, parts of speech in Listening, reading and writing.

UNIT-III 12

Group Discussion, Argumentative Skills, Interview skills, completing the steps involved in Career, Life Planning and Change Management.

UNIT-IV 12

Presentation skills, Extempore (on-spot speech delivery), Improving body language and cross- cultural communication with pictures, making an oral presentation in English.

Books & References

1. A Manual for English Language Laboratory, Sudha Rani, Pearson.
2. English Language Communication Skill (lab),
3. Malcome Goodale, –Professional Presentations|, (VCD) New Delhi: Cambridge University Press, 2005
4. Robert M. Sherfield and et al –Developing Soft Skills|,4th Edition, New Delhi, Pearson Education, 2009
5. Study Materials from CIEFL, Hyderabad

BSH-351 ENGINEERING AND MANEGERIAL ECONOMICS

Course category	:	Management (M)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 2, Tutorial : 1 , Practical: 0
Number of Credits	:	3
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, midterm examination and Theory Examination

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Students will acquire basic knowledge in Engineering & managerial economics, which allows students to gain theoretical and empirical skill of economics.
2. To make Engineering students prepared for economic empowerment so that they could manage their wealth, help them in starting their own business or during managerial period.
3. Students will develop Interdisciplinary skills which can help them to thrive in the life- long changing environment in various fields of Industry of Economics.
4. Students will acquire practical knowledge of economics, the kind of markets, cost theory, various issues of demand and other major economic concepts.
5. Able to explain succinctly the meaning and definition of managerial economics; elucidate on the characteristics and scope of managerial economics.
6. Able to describe the techniques of managerial economics.
7. Able to explain the applications of managerial economics in various aspects.
8. To learn about the management and economics of the industrial environment

Topics Covered

UNIT-I 6

Introduction: Meaning, Nature and Scope of micro Economics, Macro Economics and Managerial Economics, Decision making Process with reference to Managerial economics, Managerial Economics and its application in engineering perspective,

UNIT-II 6

Concepts of Demand and Supply: Demand Analysis, Law of Demand, Determinants of **Demand, Elasticity of Demand:** Price, Income and cross Elasticity. Uses of concept of elasticity of demand in managerial decision

Demand Forecasting: Meaning, significance and methods of demand forecasting, Law of Supply, Determinants and Elasticity of supply

UNIT-III 6

Production function, Laws of returns to scale & Law of Diminishing returns scale.

Overview of cost: fixed cost, variable cost, average cost, marginal cost, Opportunity cost, An overview of Short and Long run cost curves

Profit analysis and concept of profit, Theories of Profits

UNIT-IV 6

Market Structure: Perfect Competition, Imperfect competition – Monopolistic, Oligopoly, duopoly sorbent features of price determination and various market conditions.

National Income: Concept and Measurement of National Income. Inflation: Meanig, Types, causes & prevention methods, Business Cycles and Phases

Books & References

1. Mote, Paul and Gupta, Managerial Economics, T M H, New Delhi.
2. H L Ahuja, Managerial Economics, S Chand & Co. New Delhi
3. P.L. Mehta, Managerial Economics, Analysis, Problems and Cases, Sultan Chand Sons, New Delhi.
4. Prof. D.N. Kakkar , Managerial Economics for Engineering, PHI publication, New Delhi
5. Varshney and Maheshwari, Managerial Economics, Sultan Chand and Sons, New Delhi.

Engineering Fundamentals (EF)

CEE-111 ENGINEERING GRAPHICS

Course category	:	Engineering Fundamentals (EF)
Pre-requisite Courses	:	NIL
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 4
Number of Credits	:	2
Course Assessment methods	:	Continuous assessment through Viva voce, Practical work / record, attendance and Major Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course:

1. How Engineering Drawing helps to sketch the imagination?
2. Able to effectively practice the different scales for drawings.
3. Effectively analyze the geometrical shapes and to be able to draw.
4. Know about out solids and discuss about their classification.
5. How to implement the different views for a solid placed in 3d space.
6. Construction of the object from different perspective.
7. Comparison and contrast between frustum and truncated solid.
8. Sketching of different sections for any 3D regular object.
9. Discussing the principles of Isometric Projection.
10. Sketching isometric projections for different geometrical shapes and solids.

Topics Covered

UNIT-I 6x4

Title: Conic Sections and Orthographic Projections Introduction

Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Orthographic Projections

Orthographic Projections covering Principles of Orthographic Projections- Conventions- Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Plane

UNIT-II 3x4

Title: Projection of Regular Solids

Projections of Regular Solids covering, those inclined to both the Planes- Auxiliary Views

UNIT-III 3x4

Title: Sections and Sectional Views of Right Angular Solids

Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone

UNIT-IV 3x4

Isometric Projections

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

Textbooks

1. Engineering Drawing - Bhat, N.D.& M. Panchal, Charotar Publishing House, 2008

Reference books

1. Engineering Drawing and Computer Graphics - Shah, M.B. & B.C. Rana, Pearson Education, 2008
2. A Text Book of Engineering Drawing - Dhawan, R.K., S. Chand Publications, 2007
3. Text book on Engineering Drawing - Narayana, K.L. & P Kannaiah, Scitech Publishers, 2008

EEE- 121 PRINCIPLES OF ELECTRICAL ENGINEERING

Course category	:	Department Core (DC)
Pre-requisite Courses	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical:2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, assignments, midterm examination and Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course:

1. Able to understand the basic concepts of network and circuit.
2. To solve the basic electrical circuits.
3. Familiarity with the basic concepts of AC circuits.
4. Introductory concept of measurement, instrumentation, working & performances of different kind of measuring instruments (PMMC, MI).
5. Able solve magnetic circuits.
6. Able to analyze three phase circuits.
7. Introduction and application to different electrical machines.

Topic Covered

UNIT I

D C Circuit Analysis and Network Theorems: **9**

Circuit Concepts: Concepts of network, Active and passive elements, Voltage and current sources, Concept of linearity and linear network, Unilateral and bilateral elements, R, L and C as linear elements, Source transformation Kirchhoff's laws; Loop and nodal methods of analysis; Star-delta transformation Network theorems: Superposition theorem, Thevenin"s theorem, Norton"s theorem, Maximum Power Transfer theorem.

UNIT II

Steady- State Analysis of Single Phase AC Circuits: 9

AC fundamentals: Sinusoidal, square and triangular waveforms – Average and effective values, Form and peak factors, Concept of phasor, phasor representation of sinusoidally varying voltage and current, Analysis of series, parallel and series-parallel RLC Circuits, Resonance in series and Parallel circuit

Three Phase AC Circuits: Three phase system-its necessity and advantages, Star and delta connections, Balanced supply and balanced load, Line and phase voltage/current relations, Three-phase power and its measurement

UNIT III 9

Measuring Instruments, Magnetic Circuit & 1 phase Transformers:

Types of instruments, Construction and working principles of PMMC and Moving Iron type voltmeters & ammeters, Use of shunts and multipliers.

Magnetic circuit, concepts, analogy between electric & magnetic circuits, B-H curve, Hysteresis and eddy current losses.

Single Phase Transformer: Principle of operation, Construction, EMF equation, Power losses, Efficiency, Introduction to auto transformer.

UNIT IV 9

Electrical Machines:

Concept of electromechanical energy conversion DC machines: Types, EMF equation of generators and torque equation of motor, Characteristics and applications of DC Generators & motors. Three Phase Induction Motor: Types, Principle of operation, Torque-slip characteristics, Applications, Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications.

Three Phase Synchronous Machines: Principle of operation of alternator, emf equation, Principle of operation and starting of synchronous motor, their applications.

Text Books:

1. "Principles of Electrical Engineering", V. Del Toro,; Prentice Hall International
2. "Basic Electrical Engineering", D P Kothari, I.J. Nagarath; Tata McGraw Hill
3. "Basic Electrical Engineering", S N Singh; Prentice Hall International
4. "Fundamentals of Electrical Engineering" B Dwivedi, A Tripathi; Wiley India
5. "Electrical and Electronics Technology", Edward Hughes; Pearson

PRINCIPLES OF ELECTRICAL ENGINEERING LABORATORY

1. Verification of Kirchhoff's law
2. Verification of Norton's theorem
3. Verification of Thevenin's theorem
4. Verification of Series R-L-C circuit
5. Verification of Parallel R-L-C circuit
6. Measurement of Power and Power factor of three phase inductive load by two wattmeter method
7. To draw the magnetization characteristics of separately excited dc motor.
8. To perform the external load characteristics of dc shunt motor.
9. To perform O.C. and S.C. test of a single phase transformer

CSE-121 INTRODUCTION TO C PROGRAMMING

Course Category	:	Engineering Fundamental (EF) for other Departments
Pre-requisite Course	:	NIL
Contact Hours/Week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, midterm examination, practical work, record, viva voce and Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this Course

1. Read and understand C programs.
2. Discuss basic theory and practice of programming.
3. Design and implement practical programs using C language.
4. Use compiler and feel comfortable with Windows environment
5. Identify and fix common C errors

Topics Covered

UNIT-I 9

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, Function, Services and Types. 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-II **9**

Standard I/O in "C", Fundamental Data Types and Storage Classes: Character Types, Integer, Short, Long, Unsigned, Single and Double-Precision Floating Point, Storage Classes, Automatic, Register, Static and External, Operators and Expressions: Using Numeric and Relational Operators, Mixed Operands and Type Conversion, Logical Operators, Bit Operations, Operator Precedence and Associativity, C Conditional Program Execution: Applying if and Switch Statements, Nesting if and else, Restrictions on switch Values, Use of Break, Program Loops and Iteration: Uses of while, do and for Loops, Multiple Loop Variables, Assignment Operators, Using Break and Continue

UNIT-III **9**

Arrays: One Dimensional, Multidimensional Array and their Applications, Declaration and Manipulation of Arrays Structures: Purpose and Usage of Structures, Declaring Structures, Assigning of Structures, Strings: String Variable, String Handling Functions, Array of Strings, Functions: Designing Structured Programs, Functions in C, User Defined and Standard Functions, Formal vs. Actual Arguments, Function Category, Function Prototype, Parameter Passing, Recursive Functions. Storage Classes: Auto, Extern, Register and Static Variables

UNIT-IV **9**

Pointers: Pointer Variable and its Importance, Pointer Arithmetic and Scale Factor, Compatibility, Dereferencing, L value and R-Value, Pointers and Arrays, Pointer and Character Strings, Pointers and Functions, Array of Pointers, Pointers to Pointers Dynamic Memory Allocation Structure and Union: Declaration and Initialization of Structures, Structure as Function Parameters, Structure Pointers, Unions. File Management: Defining and Opening A File, Closing A File, Input/Output Operations in Files, Pre-Processor Directives, Command Line Arguments.

EXPERIMENTS

1. Write a program that finds whether a given number is even or odd.
2. Write a program that tells whether a given year is a leap year or not.
3. Write a program that accepts marks of five subjects and finds percentage and prints grades according to the following criteria:
   a. Between 90-100%----------Print "A"
   b. 80-90%----------Print "B"
   c. 60-80%----------Print "C"
   d. Below 60%----------Print "D"
4. Write a program that takes two operands and one operator from the user and perform the operation and prints the result by using Switch statement.
5. Write a program to print sum of even and odd numbers from 1 to N numbers.
6. Write a program to print the Fibonacci series.
7. Write a program to check whether the entered number is prime or not.
8. Write a program to find the reverse of a number.
9. Write a program to print Armstrong Numbers from 1 to 100.
10. Write a program to convert binary number into decimal number and vice versa.
11. Write a program that simply takes elements of the array from the user and finds the sum of these elements.
12. Write a program that inputs two arrays and saves sum of corresponding elements of these arrays in a third array and prints them.
13. Write a program to find the minimum and maximum element of the array.
14. Write a program to search an element in array using Linear Search.
15. Write a program to sort the elements of the array in ascending order using Bubble Sort technique.
16. Write a program to add and multiply two matrices of order NxN.
17. Write a program that finds the sum of diagonal elements of a MxN matrix.
18. Define a structure data type TRAIN_INFO. The type contain
    a. Train No.: integer type
    b. Train name: string
    c. Departure Time: aggregate type TIME
    d. Arrival Time : aggregate type TIME
    e. Start station: string
    f. End station : string
19. The structure type Time contains two integer members: hour and minute. Maintain a train Time table and implement the following operations:

i. List all the trains (sorted according to train number) that depart from a particular section.
ii. List all the trains that depart from a particular station at a particular time.
iii. List all he trains that depart from a particular station within the next one hour of a given time.
iv. List all the trains between a pair of start station and end station.

20. Write a program to swap two elements using the concept of pointers.
21. Write a program to compare the contents of two files and determine whether they are same or not.
22. Write a program to check whether a given word exists in a file or not. If yes then find the number of times it occurs.

Textbooks and reference books

1. Jeri R. Hanly, Elliot B. Koffman, Problem Solving and Program Design in C, 7th edition, Pearson
2. Childt , Herbert Complete reference with C Tata McGraw Hill
3. Kerninghan and Ritchie, The C programming language, Prentice Hall
4. Samuel P. Harbison, and Guy L. Steele Jr., C-A Reference Manual, Fifth Edition, Prentice Hall, 2002

Mechanical Engineering Department

Course offered by the Department

S. N.	Paper Code	Course	Prerequisite Course	L	T	P	Credits
1.	MEE-111	Engineering Mechanics	-	3	1	2	5
2.	MEE-121	Workshop Technology	-	0	0	4	2
3.	MEE-231	Material Science and Engineering	-	3	1	2	5
4.	MEE-232	Engineering Thermodynamics	-	3	1	0	4
5.	MEE-233	Measurement & Metrology	-	2	1	2	5
6.	MEE-234	Mechanics of Solids	-	3	1	2	5
7.	MEE-235	Mechanical Engineering Drawing	-	0	0	4	2
8.	MEE-241	Fluid Mechanics	-	3	1	2	5
9.	MEE-242	Kinematics of Machines	-	3	1	0	4
10.	MEE-243	Energy Conversion Systems	-	3	1	2	5
11.	MEE-351	Machine Design-I	MEE-234	3	1	2	5
12.	MEE-352	Heat and Mass Transfer	MEE-232	3	1	2	5
13.	MEE-353	Dynamics of Machines	-	3	1	2	5
14.	MEE-354	Manufacturing Science	-	3	1	2	5
15.	MEE-366	Seminar	-	0	0	6	3
16.	MEE-361	Machine Design-II	MEE-234	3	1	2	5
17.	MEE-362	Refrigeration & Air conditioning	-	3	1	2	5
18.	MEE-363	I C Engines	-	3	1	0	4
19.	MEE-364	Machine Tools & Machining	-	3	1	0	4

20.	MEE-365	Principles of Industrial Engineering	-	3	1	0	4
21.	MEE-471	Automobile Engineering	MEE-363	3	1	2	5
22.	MEE-472	Computer Aided Design	-	3	1	2	5
23.	MEE-473	Project Part-I	-	0	0	10	5
24.	MEE-474	Industrial/Practical Training	-	0	0	2	1
25.	MEE-481	Computer Aided Manufacturing	MEE-354	3	1	2	5
26.	MEE-482	Project Part-II	MEE-473	0	0	10	5
27.	MPE-471	Hydraulic Machines	MEE-241	3	1	2	5
28.	MPE-472	Principles of Machine Tools Design	-	3	1	0	4
29.	MPE-473	Production Planning & Control	-	3	1	0	4
30.	MPE-474	Industrial Tribology	-	3	1	0	4
31.	MPE-475	Total Quality Management	-	3	1	0	4
32.	MPE-476	Energy Management	-	3	1	0	4
33.	MPE-477	Mechanical Vibrations	-	3	1	0	4
34.	MPE-478	Renewable Energy systems	-	3	1	0	4
35.	MPE-481	Power Plant Technologies	MEE-232	3	1	0	4
36.	MPE-482	Turbo Machinery	MEE-232	3	1	0	4
37.	MPE-483	Project Management	-	3	1	0	4
38.	MPE-484	Advanced Welding Technology	-	3	1	0	4
39.	MPE-485	Advanced Manufacturing Technology	-	3	1	0	4
40.	MPE-486	Advanced Engineering Materials	-	3	1	0	4
41.	MPE-487	Advanced Mechanics of Solids	MEE-234	3	1	0	4
42.	MPE-488	Gas Dynamics and Propulsion	-	3	1	0	4
43.	MOE-481	Fundamentals of Mechanical Engineering	-	3	1	2	5
44.	MOE-482	Manufacturing Processes	-	3	1	0	4
45.	MOE-483	Engineering Materials	-	3	1	2	5

SYLLABI

MEE-111 ENGINEERING MECHANICS

Course category : Department Core (DC)
Pre-requisite Course : NIL
Contact hours/week : Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits : 5
Course Assessment methods : Continuous assessment through tutorials, attendance, home assignments, mid-term examination, practical work, record, viva voce, Theory & Practical Examination

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the laws of mechanics and two-dimensional force systems, equivalent force system, types of friction and its application in belt drives.
2. The ability to draw shear force and bending moment diagrams for beams under concentrated and uniformly distributed loads; to determine centroid of plane composite surfaces; moment of inertia of composite bodies and mass moment of inertia of simple and complex shape bodies.

3. The ability to understand the relationships of kinematic quantities of rigid bodies involving linear, curvilinear and angular motions and kinetics of rigid bodies involving general motion and application of D'Alembert's principles.
4. Understand the effects of deformation, types of stress generation and relationships among elastic constants, stresses in beams of different cross-sections in simple bending as well as stresses in circular shafts under pure torsion.

Topics Covered

UNIT-I 9

Two-dimensional Force Systems

Basic Concepts, Laws of Mechanics, System of forces, Avignon's theorem, Transfer of a force to parallel position, Equivalent force system, Resultant of concurrent and non-concurrent force system, Free body diagrams, Equations of equilibrium, Applications

Friction and Applications

Introduction, Dry friction, Rolling friction, Fluid friction, Laws of Coulomb friction, Angle of friction, Cone of friction, Angle of repose, Equilibrium of bodies involving dry friction, Bodies resting on rough horizontal and inclined planes, Belt friction-Flat and V belt, Ratio of driving tensions for flat belt, Centrifugal tension, Initial tension, Condition of maximum power

Transmission

UNIT-II 9

Beams

Introduction, Types of supports, Beams classification, Free body diagram, Shear force and bending moment, Analysis of beams, Continuous loading and discontinuous loading, Shear force and bending moment diagrams for concentrated and uniformly distributed loads

Properties of Plane Surfaces

First moment of area, Centroid of a plane and composite bodies joined by different surfaces, Surface of revolution and volume of revolution, Moment of Inertia of area, Parallel axis theorem, Perpendicular axis theorem, Moment of inertia of composite bodies, Principal axes and principal moments of inertia, Mass moment of inertia of a thin rod, thin uniform plate, thin rectangular sheet,

circular ring, thin disc, solid cylinder, sphere and cone about their axis of symmetry

UNIT-III 9

Kinematics of a rigid body

Introduction, Plane motion of a rigid body, Linear motion, Translation of a point with constant acceleration, Equation of motion due to gravity, Angular motion, Relation between angular displacement and angular velocity with constant angular acceleration, Curvilinear motion of a particle, Normal and tangential acceleration, General plane motion, Instantaneous centre of rotation **Kinetics of rigid body**

Introduction, Laws of motion, Kinetics of rigid bodies, Motion on inclined rough surface, Analysis of lift motion, Motion of two bodies connected by a string, Pure rotation of a rigid body, General motion of a rigid body, Work and energy, Linear and angular momentum, D'Alembert's principle

UNIT-IV 9

Mechanics of Deformable Bodies

Introduction, Normal and shear stresses, Poisson‘s ratio, Elastic constants and their relationships, Generalized Hooke‘s law, Deflection of bars of uniform and varying cross-sections, Strain energy in members due to static loading, Statically determinate problems, Stress-strain diagrams for ductile and brittle materials; Pure Bending of beams, Assumptions, Simple bending theory, Stress of beams of different cross sections ; Torsion of Circular shafts, Shear stress due to torsion, Polar modulus, Power transmission

EXPERIMENTS

Note: Minimum Eight experiments are to be performed

1. Tensile strength test on universal testing machine
2. Compressive strength test on universal testing machine
3. Impact test on Impact testing machine
4. Hardness testing of given specimen on Vicker/Brinell hardness testing machine
5. Torsion test of a rod on torsion testing machine
6. Determination of closed coil and open coil spring stiffness on spring testing machine
7. Experiments on friction between belt and pulley
8. Experiments on flywheel
9. Friction experiments on inclined plane/Screw jack
10. Experiments on bending of simple supported and cantilever beams
11. Statics experiments on equilibrium
12. Experiment on moment of inertia

Books & References

1. Engineering Mechanics: Statics and dynamics - I.H. Shames (PHI)
2. Vector Mechanics for Engineers, Vol I - Statics, Vol II – Dynamics, F. P. Beer and E. R. Johnston (Tata McGraw Hill).
3. J. L. Meriam and L. G. Kraige, Engineering Mechanics, Vol I – Statics, Vol II – Dynamics, J. L. Meriam and L. G. Kraige (John Wiley).
4. Engineering Mechanics: Principles of Statics and Dynamics R. C. Hibbler, (Pearson Press).
5. Engineering Mechanics -S S Bhavikatti (New Age International)
6. Engineering Mechanics - D S Kumar (Katson)
7. Engineering Mechanics, M. K. Harbola, (Cengage Learning)
8. Engineering Mechanics - H D Ram and A K Chauhan (McGraw Hill)
9. Engineering Mechanics- R. K. Bansal (Laxmi Publications)

MEE-121 WORKSHOP TECHNOLOGY

Course category	:	Department Core (DC)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 4
Number of Credits	:	2
Course Assessment Methods	:	Continuous assessment through Viva voce, Practical work/record, attendance and Final Practical Examination

Course Outcomes : After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Understand the importance, materials, applications and safety in different shops for the development of a product/component.
2. The knowledge of tools and processes used in carpentry and foundry shops for the development of products through casting process.
3. The knowledge of forming process will develop skills for producing products using different tools and processes in black smithy and sheet metal shops.
4. The knowledge of tools and processes in machine shop and welding shop will develop ability of producing different products.

Topics Covered

Note: Make at least one job in each shop

1. **Introduction**
   - Need and importance of workshop
   - Mechanical properties of metals
   - Ferrous Metals and alloys- composition and applications
   - Non-Ferrous Metals and alloys- composition and applications
   - Safety in each shop
2. **Carpentry Shop:**
   - Draw layout of carpentry shop
   - Study of tools & operations and carpentry joints.
   - Preparation of half-lap corner joint, mortise & tennon joint
   - Simple exercise on woodworking lathe
3. **Fitting Shop:**
   - Layout of fitting shop
   - Study of tools & operations
   - Simple exercises involving fitting work.
   - Simple exercises involving drilling/tapping/die
4. **Black Smithy Shop:**
   - Layout of Smithy Shop
   - Study of tools & operations
   - Hot and cold working
   - Simple exercises base on black smithy operations such as upsetting, drawing down, punching, bending, fullering & swaging.
5. **Welding Shop:**
   - Layout of welding shop
   - Study of equipment of gas welding & arc welding
   - Preparation of simple butt and lap welded joints.
   - Oxy-acetylene flame cutting
6. **Sheet-metal Shop:**
   - Layout of Sheet metal shop
   - Metals used in sheet metal work such as Galvanized iron, Copper sheet, Aluminum sheet

- Study of tools & operations
- Fabrication of Funnel, tool-box, tray, electric panel box etc.

7. **Machine Shop:**
   - Layout of Machine shop
   - Study of Lathe, Drilling, Shaper, Planer and Milling Machines and commonly done operations on these machines
   - Single point and Multi-point Cutting tools
   - Making a job on lathe involving plane turning step turning, taper turning, and threading operations
8. **Foundry Shop:**
   - Layout of foundry shop
   - Study of tools & operations
   - Study on pattern allowances
   - To prepare a mould with the use of a core and cast it
   - Study of casting defects

MEE-231 MATERIAL SCIENCE AND ENGINEERING

Course category	:	Basic Science & Maths (BSM)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, practical work, record, viva voce & Practical and theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the importance of numerous materials with their Basic concepts including crystallography and imperfections.
2. The understanding about the advanced materials testing by different testing methods such as strength, hardness, fatigue, NDT, etc.
3. The knowledge of different surface behavior studies of engineering materials including heat treatment processes, TTT diagram and other related processes.
4. The knowledge of different concepts regarding materials and electrical, magnetic, electronic, etc. properties.

Topics Covered

UNIT-I 9

Introduction

Historical perspective, importance of materials, Crystallography and imperfections: Concept of unit cell, space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices, X-ray crystallography techniques, imperfections, Defects & Dislocations in solids

UNIT-II 9

Mechanical Properties and Testing

Stress strain diagram, Ductile and brittle materials, stress Vs strength, toughness, hardness, fracture, fatigue and creep. Testing, such as Strength testing, Hardness testing, Impact tests, Fatigue testing Creep testing, Non-destructive testing (NDT). Performance of materials in service: Brief theoretical consideration of fracture, fatigue, and corrosion and its control.

Micro Structural Examination

Microscope principle and methods, Preparation of samples and microstructure exam and grain size determination, comparative study of microstructure of various metals and alloys, such as Mild steel, CI, Brass.

Phase Diagram and Equilibrium Diagram

Uniary and Binary diagrams, Phase rules, Types of equilibrium diagrams: solid solution type, eutectic type and combination type, Iron-carbon equilibrium diagram.

UNIT-III 9

Ferrous & Non-ferrous materials

Iron and steel manufacture, furnaces, various types of carbon steels, alloy steels and cast irons, its properties and uses. 3 Heat Treatment: various types of heat treatment, such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams.

Non-Ferrous metals and alloys

Non-ferrous metals, such as Cu, Al, Zn, Cr, Ni etc. and its applications

UNIT-IV 9

Magnetic properties

Concept of magnetism- Dia, para, ferro magnetic materials, Hysteresis, Soft and hard magnetic materials, Magnetic Storages.

Electrical Properties

Energy band, concept of conductor, insulator and semi conductor. Intrinsic and extrinsic semi-conductors, P-n junction and transistors, basic devices and their applications, diffusion of Solid, Super conductivity and its applications, Messier effect. Type I & II superconductors. High Temp. superconductors Brief description of other material such as optical and thermal materials, Composite Materials and its uses. Smart materials & Nano-materials and their potential applications

EXPERIMENTS

Minimum Eight experiments are to be conducted from the following:

1. Tensile test on universal testing machine
2. Compressive on universal testing machine
3. Torsion test of a rod on torsion testing machine
4. Creep test on creep testing machine
5. Fatigue test on fatigue testing machine
6. Hardness testing of given specimen on Vicker/Brinell/Rockwell hardness testing machine
7. Determination of deflection of cantilever under point/uniformly distributed loading
8. Determination of deflection of beam under point/uniformly distributed loading
9. Study of corrosion and its effects.
10. Comparative study of microstructures of different specimens of different materials (mild steel, gray C.I., brass, copper etc.)

11. Study of heat treatment processes such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after heat treatment.
12. Study of non destructive testing methods such as ultrasonic flaw detector, magnetic flaw detector and eddy current testing machine

Books & References

1. Material Science and Engineering – Smith, Hashemi and Prakash (Tata McGraw Hill)
2. Material Science- Narula (Tata McGraw Hill)
3. Material Science for Engineering Students- Fischer (Academic Press)
4. Material Science & Engineering - Van Vlash (John Wiley & Sons)
5. Elements of Material Science & Engineering -W.D. Callister (Wiley India Pvt. Ltd.)
6. Technology of Engineering Materials- Philip and Bolton (Butterworth-Heinamann)
7. Material Science -V. Raghvan (Prentice Hall of India)
8. Elements of Material Science & Engineering- Van Vlack (Pearson)

MEE-232 ENGINEERING THERMODYNAMICS

Course category	:	Engineering Fundamentals (EF)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The Basic understanding of the nature of the Thermodynamic processes for pure substances and ideal gases and ability to demonstrate the Zeroth law and First Law of Thermodynamics.
2. Ability to apply the First Law of Thermodynamics for control surface and control volume systems and demonstrate the Second Law of Thermodynamics and its application to various systems.
3. Students will demonstrate ability to use the Second Law of Thermodynamics for entropy balance analysis of different Thermodynamics processes of systems and control volume.
4. Ability to demonstrate the various plots pertaining to properties of steam and Thermodynamic cycles and the working of IC Engines.

Topics Covered

UNIT-I 9

Fundamental Concepts and Definitions

Introduction and definition of thermodynamics, Dimensions and units, Microscopic and Macroscopic approaches, Systems, surroundings and universe, Concept of continuum, Control system boundary, control volume and control surface, Properties and state, Thermodynamic properties, Thermodynamic path, process and cycle, Thermodynamic equilibrium, Reversibility and irreversibility, Quasi static process, Energy and its forms, Work and heat, Gas laws, Ideal gas, Real gas, Law of corresponding states, Dalton‘s law, Amagat‘s law, Property of mixture of gases.

Zeroth law of thermodynamics

Zeroth law of thermodynamics, Temperature and its‘ measurement, Temperature scales

First law of thermodynamics-I

Thermodynamic definition of work, Thermodynamic processes, Calculation of work in various processes and sign convention, Non-flow work and flow work, Joules‘ experiment, First law of thermodynamics, Internal energy and enthalpy

UNIT-II 9

First law of thermodynamics-II

First law of thermodynamics applied to open systems, Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc. First law analysis for closed system (non flow processes), Analysis of unsteady processes such as filling and evacuation of vessels with and without heat

transfer, Limitations of first law of thermodynamics, PMM-I

Second law of Thermodynamics

Devices converting heat to work, Thermal reservoir, Heat engines, Efficiency, Devices converting work to heat, Heat pump, refrigerator, Coefficient of Performance, Reversed heat engine, Kelvin Planck statement of second law of thermodynamics, Clausius statement of second law of thermodynamics, Equivalence of two statements of second law of thermodynamics, Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and it‘s corollaries, thermodynamic temperature scale, PMM-II

UNIT-III 9

Entropy

Clausius inequality, Concept of Entropy, Entropy change in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics.

Availability and Irreversibility

Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz & Gibb‘s function

UNIT-IV 9

Properties of steam and thermodynamics cycles

Pure substance, Property of steam, Triple point, Critical point, Sub-cooled liquid, Saturation states, Superheated states, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T & P-V diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables & Mollier charts, Dryness factor and it‘s measurement, processes involving steam in closed and open systems, Simple Rankine cycle

Introduction to working of IC engines

Compression Ignition engines, Spark Ignition engines, 2 stroke and 4 stroke engines, Performance parameters of IC engine, Heat balance sheet

Books & References

1. Engineering Thermodynamics - P.K. Nag (Tata McGraw Hill)
2. Fundamentals of Thermodynamics – Sonntag (Wiley India Pvt. Ltd)
3. Fundamentals of Classical Thermodynamics - Van Wylen (John Wiley & sons)
4. Thermodynamics - J.P. Holman (McGraw Hill)
5. Engineering Thermodynamics - Jones and Dugans (PHI Learning Pvt. Ltd)

MEE-233 MEASUREMENT & METROLOGY

Course category	:	Department Core (DC)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 2, Tutorial : 1 , Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, practical work, record, viva voce & Practical and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understanding of measurement and measuring instruments, sensors and transducers, signal transmission and processing.
2. The knowledge of time related measurements, measurements of pressure, strain, temperature, force, torque, acceleration and vibration.
3. The knowledge of standards of linear measurement, line and end standards, limit fits and tolerances, interchangeability and standardization, linear and angular measuring devices and systems, comparators, limit gauges and gauge design.
4. The knowledge of measurement of geometric forms like straightness, flatness, roundness, tool maker‘s microscope, profile project autocollimator, Interferometry, Measurement of screw threads, gears and surface texture.

Topics Covered

UNIT-I 6

Mechanical Measurements

Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error, statistical analysis of errors.

Sensors and Transducers

Types of sensors, types of transducers and their characteristics

Signal transmission and processing

Devices and systems, Signal Display & Recording Devices

UNIT-II 6

Time related measurements

Counters, stroboscope, frequency measurement by direct comparison, Measurement of displacement

Measurement of pressure

Gravitational, directing acting, elastic and indirect type pressure transducers

Strain measurement

Types of strain gauges and their working, strain gauge circuits, temperature compensation

Measurements of force and torque

Different types of load cells, elastic transducers, pneumatic& hydraulic systems

Temperature measurement

Thermometers, bimetallic thermocouples, thermistors and pyrometers

UNIT-III 6

Standards of linear measurement, line and end standards. Limit fits and tolerances. Interchangeability and standarisation, Linear and angular measurements devices and systems Comparators: Sigma, Johansson‘s Microkrator, Limit gauges classification, Taylor‘s Principle of Gauge Design.

UNIT-IV 6

Metrology-II

Measurement of geometric forms like straightness, flatness, roundness, Tool makers microscope, profile project autocollimator, Principle and use of interferometry, optical flat, Measurement of screw threads and gears, Surface texture: quantitative evaluation of surface roughness and its measurement.

Measurement and Inspection

Dimensional inspection–Tolerance, Limit gauging, comparators, Surface roughness, Feature inspection

EXPERIMENTS

Minimum Eight experiments are to be conducted from the following:

1. To measurement of strain (gauge) through MS flat iron with help of Digital Strain indicator.
2. Measurement of displacement using linear variable differential transducer (LVDT)
3. To determine the temperature of bulb filament with the help of partial radiation pyrometer
4. To demonstrate the application of the law of intermediate Temperature
5. To measure the diameter of 'GO' and 'NOT GO' Ends of a plug gauge with the help of micrometer and to determine the tolerance provide.
6. To measure the amount of clearance provided in the given fit with the help of dial caliper
7. To measuring the included angle of given hexagonal/ octagonal piece with the help of venire bevel protractor and to verify the same using the formula.
8. To measure the taper angle of given with the help of slip gauges and sine bar.
9. To measure the effective diameter of a screw thread using three wire method of a 1" BSW tap and find the flomle angle.
10. To study and sketch of tool mater microscope for measurement of dimensional parameters of the given work piece

Books & References

1. Mechanical Measurement - Jain, R.K (Khanna Publishers)
2. Mechanical Measurements and Control - Kumar D.S. (Metropolitan, N. Delhi)
3. Engineering Metrology - Hume K.J. (MacDonald and Co. 1963)
4. Mechanical Measurement – Sirohi (New Age Publishers)
5. Engineering Metrology- Gupta, I.C. (Dhanpat Rai & Sons, New Delhi, 1994)
6. Mechanical Measurements - Beckwith Thomas G. (Narosa Publishing House, N. Delhi)
7. Measurement Systems, Application Design - Doeblein E.O (McGraw Hill, 1990.)

MEE-234 MECHANICS OF SOLIDS

Course category : Department Core (DC)
Pre-requisite Course : NIL
Contact hours/week : Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits : 4

Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The ability to determine stresses in beams and shafts under different loading conditions; understand Hooke‘s law and different theories of failure criteria.
2. The ability to calculate deflections in beams under different support conditions, deflection in helical and leaf springs under different loading conditions.
3. The ability to determine stresses in thin and thick cylindrical and thin spherical shells, and buckling loads in long columns under different support conditions.
4. The ability to determine stresses in curved beams and location of neutral axis, stresses and deflections in beams of different cross-sections subjected to unsymmetrical bending.

Topics Covered

UNIT-I 9

Compound stress and theory of failure

Introduction, Stresses due to different types of loads, Principal planes and principal stresses, Mohr‘s stress circle, Combined bending and torsion, Strain energy due to principal stresses, Energy of distortion and dilatation, Generalized Hooke‘s law, Theory of failure

Stresses in beams and circular shafts

Review of pure bending, combined direct and bending stresses, shear stresses in beams Review of torsion, combined bending and torsion of solid and hollow circular shafts

UNIT-II 9

Deflection of beams

Equation of elastic curve, Cantilever and simply supported beams, Mecaulay‘s method, Area moment method, Fixed beam carrying point load and uniformly distributed load, continuous beams, Clapeyron‘s theorem, Castgliano‘s theorem

Helical and Leaf springs

Helical springs under axial loads and axial twist, Deflection of spring by energy method, Open and closed coil helical springs under axial and twist loadings, Semi-elliptical laminated spring

UNIT-III 9

Thin cylindrical and spherical shells

Hoop and axial stresses and strain, Design of cylindrical shell, Cylindrical shell with hemispherical ends, Volumetric strain, Wire wound cylinders, spherical shell

Thick cylindrical shell

Stresses in thick cylinders subjected to internal or external pressures, Design of thick cylindrical shell, Compound cylinders, Stresses due to interference fits

Columns and Struts

Classification, Euler‘s theory for long column for different end conditions, Limitations, Rankine formulae for struts/columns

UNIT-IV 9

Curved Beams

Bending of beams with large initial curvature, Position of neutral axis for rectangular, circular, triangular and trapezoidal cross-sections, Stresses in crane hooks and circular rings under tension and compression

Unsymmetrical bending and Shear centre

Stresses due to unsymmetrical bending, Deflection of beams due to unsymmetrical bending, Determination of shear centre and flexural axis for I-section and channel section

Books & References

1. Introduction of Mechanics of Materials – I.H. Shames
2. Strength of Materials-S. Ramamurtham (Dhanpat Rai Publishing Co.)
3. Strength of Materials-R. K. Rajput (S. Chand)
4. Strength of Materials-Ryder (Mcmillan Publishers India Limited)
5. Strength of Materials-Timoshenko and Young (Tata McGraw Hill)
6. Advanced Mechanics of Solids-L S Srinath (Tata McGraw Hill)
7. Mechanics of Solids – Egor P. Popov (Pearson)
8. Mechanics of materials-Pytel (CL Engineering)

MEE-241 FLUID MECHANICS

Course category	:	Department Core (DC)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, practical work, record, viva voce & Practical and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The fundamental concepts of fluid mechanics and knowledge of fluid and its properties, types of fluid flows, 3D fluid flow, etc.
2. The knowledge of parameters of fluid statics, pressure transducers and pressures on plane and curved surfaces, stability of immersed and floating bodies.
3. Understand the various aspects of Laminar and Turbulent Flow.
4. The ability to carry out dimensional analysis and control volume analysis in fluid mechanics.

Topics Covered

UNIT-I 9

Introduction

Fluid and continuum, Physical properties of fluids, Rheology of fluids

Kinematics of Fluid flow

Types of fluid flows: Continuum & Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and

supercritical flows, one, two and three dimensional flows, streamlines, continuity equation for 3D and 1D flows, circulation, stream function and velocity potential, source, sink, doublet and half-body

UNIT-II 9

Fluid Statics

Pressure-density-height relationship, manometers, pressure transducers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies.

Dynamics of Fluid Flow

Euler's Equation of motion along a streamline and its integration, Bernoulli's equation and its applications-Pitot tube, orifice meter, venturi meter and bend meter, notches and weirs, momentum equation and its application to pipe bends.

UNIT-III 9

Laminar and Turbulent Flow

Equation of motion for laminar flow through pipes, Stokes' law, transition from laminar to turbulent flow, turbulent flow, types of turbulent flow, isotropic homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and networks.

UNIT-IV 9

Dimensional Analysis and Hydraulic Similitude

Dimensional analysis, Buckingham's Pi theorem, important dimensionless numbers and their significance, geometric, kinematics and dynamic similarity, model studies

Boundary Layer Analysis

Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sublayer, separation and its control, Drag and lift, drag on a sphere, a two dimensional cylinder, and an aerofoil, Magnus effect.

EXPERIMENTS

Minimum Eight experiments are to be conducted from the following:

1. To verify the momentum equation using the experimental set-up on impact of jet.
2. To determine the coefficient of discharge of an orifice of a given shape. Also to determine the coefficient of velocity and the coefficient of contraction of the orifice mouth piece.
3. To calibrate an orifice meter and study the variation of the co-efficient of discharge with the Reynolds number.
4. To calibrate a Venturimeter and study the variation of the co-efficient of discharge with the Reynolds number.
5. To calibrate a bend meter and study the variation of the co-efficient of discharge with the Reynolds number. .
6. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
7. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.

8. To study the variation of friction factor, 'f' for turbulent flow in commercial pipes.
9. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.
10. To determine Meta-centric height of a given ship model.
11. To determine the head loss for a sudden enlargement
12. To determine the head loss for a sudden Contraction

Books & References

1. Introduction of fluid mechanics & Fluid Machines - Som, S.K. & Biswas G. (TMH, 2000, 2e)
2. Fluid Mechanics & Turbomachines -M M Das (Oxford University Press)
3. Fluid Mechanics & Machinery - S.K. Agarwal (TMH)
4. Fluid Mechanics through Problems - Garde, R.J. (New Age International Pvt. Ltd, 2e)
5. Mechanics of Fluids -I.H. Shames (McGraw Hill, Int. Student, Education, 1988)
6. Fluid Mechanics - Jagdish Lal (Metropolitan Book Company)
7. Elementary Mechanics of Fluids -Hunter Rouse (John Wiley & Sons Omc. 1946)

MEE-242 KINEMATICS OF MACHINES

Course category	:	Department Core (DC)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The knowledge of kinematic links, its classification and applications in different planar mechanisms and machines, and ability to determine kinematic quantities in different planar mechanisms.
2. The knowledge of different types of mechanisms consisting of lower pairs, and kinematic synthesis of slider crank mechanism and four bar mechanism.
3. The knowledge of gear tooth profiles, terminology, law of gearing and calculation of minimum number of teeth to avoid interference and study different types of gear trains for power transmission
4. The knowledge of different types of cams and followers motions, cam profile generation techniques for different types of follower motion, and analytical methods of cam design

Topics Covered

UNIT-I 9

Introduction

Links-types, Kinematics pairs-classification, Constraints-types, Degrees of freedom of planar mechanisms, Grubler‘s equation, linkage mechanisms, inversions of four bar chain, slider crank chain and double slider crank chain

Velocity in Mechanisms

Relative velocity method, Velocities in four bar mechanism, slider crank mechanism and quick return motion mechanism, Instantaneous center method, Types & location of instantaneous centers, Kennedy‘s theorem, Velocities in four bar mechanism & slider crank mechanism

Acceleration in Mechanisms

Acceleration of a point on a link, Acceleration diagram, Coriolis component of acceleration, Klein‘s construction for four bar mechanism and slider crank mechanism

UNIT-II 9

Mechanisms with Lower Pairs

Pantograph, Exact straight line motion mechanisms-Peaucellier‘s, Hart and Scott Russell mechanisms, Approximate straight line motion mechanisms–Grass-Hopper, Watt and Tchebicheff mechanisms

Kinematic Synthesis of Planar Linkages

Graphical method-Two and Three position synthesis of four bars and slider crank mechanisms, Analytical method-Freudenstein‘s equation, Slider crank mechanism, Classification of synthesis problem, Precision points for function generation

UNIT-III 9

Gears

Classification & terminology, Law of gearing, Tooth forms & comparisons, Systems of gear teeth, Contact ratio, Interference & under cutting in involute gear teeth, Minimum number of teeth on gear and pinion to avoid interference

Gear Trains

Simple, Compound, Reverted and epicyclic gear trains, Sun and planet gear

UNIT-IV 9

Cams

Cams and Followers-Classification & terminology, Follower motion-Uniform velocity, Simple harmonic motion and Uniform acceleration and retardation, Cam Profile, Graphical Methods- Radial cam, Knife edge, roller and flat face followers, Analytical methods of cam design – tangent cam with reciprocating roller follower and circular arc cams with flat faced follower

Books & References

1. Theory of Machines-S.S. Rattan (Tata McGraw Hill)
2. Theory of Machines and Mechanisms-Ghosh & Mallik (East West Press)
3. Theory of Machines and Mechanisms- Shigley (McGraw Hill)
4. Theory of Machines and Mechanisms- Rao & Dukkipati (New Age International)
5. Theory of Machines - Thomas Bevan (Pearson Education)
6. Theory of Machines – Malhotra & Gupta (Satya Prakasan, Tech. India)

MEE-243 ENERGY CONVERSION SYSTEMS

Course category : Department Core (DC)
Pre-requisite Course : NIL
Contact hours/week : Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits : 5

Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, practical work, record, viva voce & Practical and theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the general principles of mass and energy conservation, thermodynamic relations; ability to analyze combustion of fuels, heat reaction and calculation, study different types of condensers and its performance parameters.
2. The knowledge of different types of boilers, their mountings and accessories, heat balance and different types of vapor power cycles
3. Study steam engines and applications of steam in steam and gas nozzles, different types of steam turbines and related parameter calculations.
4. The knowledge of principles and working of gas turbines, actual and ideal gas turbine cycles, jet propulsion and introduction to rocket engine.

Topics Covered

UNIT-I 9

Thermodynamic relations

Conditions for exact differentials, Maxwell relations, Clapeyron equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic and Isothermal compressibility

Fuels and Combustion

Combustion analysis, heating values, air requirement, Air/Fuel ratio, standard heat of reaction and effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature. Condenser: Classification of condenser, air leakage, condenser performance parameters

UNIT-II 9

Boilers

Classifications and working of boilers, boiler mountings and accessories, Draught and its calculations, air pre heater, feed water heater, super heater. Boiler efficiency, Equivalent evaporation, Boiler trial and heat balance

Vapour Power cycles

Carnot vapour power cycle, Rankine cycle, effect of pressure and temperature on Rankine cycle, reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration.

UNIT-III 9

Steam Engines

Modified Rankine cycles, working and classification of steam engines, Indicator diagram, Saturation curve, Missing quantity, Heat balance

Steam and Gas Nozzles

Flow through Convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, Choked flow, throat area, Nozzle efficiency, Off design operation of nozzle, Effect of friction on nozzle, Super saturated flow.

Steam Turbines

Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, Reheat factor, Bleeding, Velocity diagram of simple and compound multistage

impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, state point locus, Losses in steam turbines, Governing of turbines, Comparison with steam engine.

UNIT-IV 9

Gas Turbines

Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles.

Jet Propulsion

Introduction to the principles of jet propulsion, Turbojet and turboprop engines and their processes, Principle of rocket propulsion, Introduction to Rocket Engine.

EXPERIMENTS

Minimum Eight experiments are to be conducted from the following

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

Books & References

1. Basic and Applied Thermodynamics - P.K. Nag (TMH)
2. Applied Thermodynamics for Engineering Technologists- Eastop (Pearson Education)
3. Applied thermodynamics - Onkar Singh (New Age International)
4. Applied Thermodynamics - Venkanna & Swati (PHI)
5. Thermodynamics and Energy Systems Analysis - Borel and Favrat (CRC Press)
6. Mechanics and Thermodynamics of Propulsion - Hill and Peterson (Pearson Education)
7. Gas turbine Theory & Practice - Cohen & Rogers (Addison Wesley Long man)

MEE-235 MECHANICAL ENGINEERING DRAWING

Course category : Engineering Fundamentals (EF)
Pre-requisite Course : NIL
Contact hours/week : Lecture : 0, Tutorial : 0 , Practical: 4
Number of Credits : 2

Course Assessment methods	:	Continuous assessment through three Viva, Practical work/record, attendance and Major Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand layout of drawing sheet, IS codes, scales, different types of lines, section lines, dimensioning, etc.
2. The orthographic projections of simple solids; drawings of parts of temporary fastener, i.e., nuts and bolts and permanent fasteners, i.e., riveted joints and its applications to boiler joint.
3. The knowledge of assembly drawing of cotter joint, knuckle joint, stuffing box, etc. and production drawing of simple machine components
4. The knowledge of Basic commands and development of drawings of simple solids in AutoCAD software and free hand sketching of machine components.

Topics Covered

UNIT-I

Introduction (1 drawing sheet) 8

Graphics Language, Classification of machine drawings, Layout of drawing sheet, IS codes, Scales, Lines, Section lines, Dimensioning

Orthographic Projections (2 drawing sheets) 8

Introduction, Principles of first angle and third angle projection, Orthographic views, Drawing of machine elements in first angle projection, Selection of views, Sectional views, Missing views

Fasteners Drawing (2 drawing sheets) 8

Temporary fasteners-Screw threads nomenclature, Bolts and nuts

Permanent fasteners-Rivets and riveting, Types of rivet heads, Types of riveted joints, Boiler joint

Assembly Drawing (2 drawing sheets) 8

Assembly drawing of cotter joint, knuckle joint, stuffing box, cross head, pedestal bearing, eccentric, lathe tail stock, screw jack, safety valve etc.

Production Drawing (1drawing sheet) 4

Types, Use of different symbols such as machining, surface roughness symbols etc, Examples of simple machine elements gear, crank, jig, connecting rod, pulley, piston etc

Computer Aided Drafting (2 drawings) 8

Introduction to drafting software like AutoCAD, Basic commands and development of 2D and 3D drawings of simple parts

Free hand sketching* 4

Introduction, Need for free hand sketching,

Draw free hand sketching of the following machine components on sketch book

1. Conventional representations of engineering materials
2. Locking arrangements of nuts
3. Types of foundation bolts
4. Types of studs

5. Types of pulleys
6. Types of keys
7. Rigid coupling or Flexible coupling
8. Types of Welded symbols
9. Surface Roughness nomenclature, machining symbols, indication of surface roughness

Note: **Students are required to submit the free hand sketching assignment at the end of the semester*

Books & References

1. Machine Drawing - KL Narayana, P Kannaiah, KV Reddy (New Age)
2. Machine Drawing - PS Gill (SK Kataria & Sons)
3. Machine Drawing -N. Siddeshswar, P Kannaiah, VVS Shastry (Tata McGraw Hill)
4. Engineering Drawing - RK Dhawan (S. Chand)
5. AutoCAD-S. Vshal (Dhanpat Rai)
6. Engineering Graphics - BK Goel & PK Goel (SK Kataria)
7. Computer Aided Engineering Graphics - Rajashekhar Patil (New Age)
8. Engineering Drawing - Dhananjay A Jolhe (Tata McGraw Hill)
9. Engineering Drawing - CM Agrawal (Tata McGraw Hill)

MEE-351 MACHINE DESIGN-I

Course category	:	Department Core (DC)
Pre-requisite Course	:	Mechanics of Solids (MEE-234)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, practical work, record, viva voce & Practical and theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The understanding of design of mechanical components/systems, associated design parameters and standards, and knowledge of engineering materials and their properties.
2. The ability to design mechanical components under the static loads and dynamic loads based on different criteria.
3. The ability to design temporary and permanent joints such as riveted, bolted and welded joints as well as design of cotter and knuckle joints and its engineering applications.
4. The knowledge of design of circular shafts under the combined loadings, selection of keys, and design of rigid & flexible couplings.

Topics Covered

UNIT-I 9

Introduction

Definition, Design requirements of machine elements, General design procedure, Introduction to Design for Manufacturing, Interchangeability, Limits, Fits and Tolerances, Standards in design, Selection of preferred sizes

Engineering materials and their properties

Classification, Mechanical properties, Ferrous and non-ferrous metals, Non metallic materials, Indian Standards designation of carbon & alloy steels, Selection criteria of materials

UNIT-II 9

Design under Static Load

Modes of failure, Factor of safety and basis of determination, Principal stresses, Torsional and bending stresses, Principal stresses in design of machine element, Theory of failure, Eccentric loading

Design under Variable Loads

Cyclic stresses, Fatigue and endurance limit, Factors affecting endurance limit, Stress concentration factor, Stress concentration factor for machine components, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria

UNIT-III 9

Design of Joints

Design of threaded joints, Preload on the bolt, stiffness of bolt and members, efficiency of joints; Design of weld joints, Specification of welds, weld design under different loading conditions, Design of riveted joints.

Cotter and Knuckle Joint

Types of cotter joints, Design of socket and spigot cotter joint, Gib and cotter joint, Design of knuckle joint

UNIT-IV 9

Design of Shafts

Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity

Keys and Couplings

Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings-Design of rigid and flexible couplings

Note: Design data book is allowed in Minor/Major Examinations

EXPERIMENTS

Note: Minimum **Eight** experiments are to be performed from the following. Students are advised to use design data book for the design. Drawing shall be made wherever necessary on small drawing sheets

1. Design of machine components subjected to steady loads
2. Design of machine components subjected combined steady and variable loads
3. Design of boiler riveted joint
4. Design of eccentrically loaded riveted joint
5. Design & drawing of Cotter joint
6. Design & drawing of Knuckle joint
7. Design of shaft for combined constant twisting and bending loads
8. Design of shaft subjected to fluctuating loads
9. Design and drawing of flanged type rigid coupling
10. Design and drawing of flexible coupling

Books & References

1. Mechanical Engineering Design – Joseph E. Shigely (McGraw Hill)
2. Mechanical Design of Machine Components – Norton (Prentice Hall)
3. Fundamentals of Machine Components Design – Juvinall (Wiley)
4. Design of Machine Members - Alex Valance and VI Doughtie (McGraw Hill)
5. Machine design-M.F. Spott (Prentice Hall India)
6. Machine Design-Maleev and Hartman (CBS)
7. Machine design -Black & Adams (McGraw Hill)
8. Machine Design-Sharma and Agrawal (S.K. Katara & Sons)
9. Design of Machine Elements-V.B. Bhandari (Tata McGraw Hill)

MEE-352 HEAT AND MASS TRANSFER

Course category	:	Department Core (DC)
Pre-requisite Course	:	Engineering Thermodynamics (MEE-232)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, practical work, record, viva voce & Practical and theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the Basic laws of heat transfer and steady state one-dimensional heat conduction for different co-ordinate systems.
2. The knowledge of application of fins for enhancing the heat transfer rate and natural heat convection over the surfaces of different shapes.
3. The understanding of concepts and estimation of heat transfer under the forced convection, condensation and boiling phenomenon on surfaces and pipes and able to design the different types of heat exchangers.
4. The understanding of concepts and analysis of thermal radiation and its numerical solutions and introduction to mass transfer.

Topics Covered

UNIT-I 9

Introduction to Heat Transfer

Concepts of the mechanisms of heat flows; Conduction, convection and radiation; Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism

Conduction

One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; Initial and boundary conditions.

Steady State one-dimensional Heat conduction

Composite Systems in rectangular, cylindrical and spherical coordinates without energy generation; Thermal resistance concept; Analogy between heat and electricity flow; Thermal contact resistance; Critical thickness of insulation. Concept of overall heat transfer coefficients.

UNIT-II 9

Fins

Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells

Natural Convection

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

UNIT-III 9

Forced Convection

Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Empirical heat transfer relations; Flow inside ducts; Relation between fluid friction and heat transfer.

Condensation And Boiling

Introduction to condensation phenomena; Heat transfer relations for laminar film, condensation on vertical surfaces and on outside & inside of a horizontal tube, Heat pipes; Boiling modes, pool boiling

Heat Exchanger

Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers.

UNIT-IV 9

Thermal Radiation

Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck‘s law, Wein‘s displacement law, Stefan Boltzmann law, Kirchoff‘s law; Gray body; Shape factor; Black- body radiation; Radiation exchange between diffuse non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation

Introduction To Mass Transfer

Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film

EXPERIMENTS

Minimum Eight experiments are to be conducted from the following

1. Conduction - Composite wall experiment
2. Conduction - Composite cylinder experiment
3. Convection - Pool Boiling experiment
4. Convection - Experiment on heat transfer from tube-natural convection.
5. Convection - Heat Pipe experiment.
6. Convection - Heat transfer through fin-natural convection.

7. Convection - Heat transfer through tube/fin-forced convection.
8. Any experiment on Stefan's Law, on radiation determination of emissivity, etc.
9. Any experiment on solar collector, etc.
10. Heat exchanger - Parallel flow experiment
11. Heat exchanger - Counter flow experiment
12. Any other suitable experiment on critical insulation thickness.
13. Conduction - Determination of thermal conductivity of fluids.
14. Conduction - Thermal Contact Resistance Effect.

Books & References

1. Elements of Heat Transfer - Bayazitouglu & Ozisik (McGraw-Hill)
2. Heat Transfer - J.P. Holman (McGraw-Hill International)
3. Schaum's outline of Heat Transfer - Pitts & Sisson (McGraw-Hill International)
4. Principles of Heat Transfer - Frank Kreith (McGraw-Hill Book)
5. Heat Transfer - Vijay Gupta (New Age International (P) Ltd.)
6. Heat Transfer -Y.V.C. Rao (University Press)
7. Heat Transfer - R. Yadav (Central Publishing House)
8. Fundamentals of heat transfer – Incropera, Dewitt (Wiley)
9. Heat Transfer - D S Kumar (S Chand)

MEE-353 DYNAMICS OF MACHINES

Course category	:	Department Core (DC)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, practical work, record, viva voce & Practical and theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The students will be able to carry out static and dynamic force analysis of four bars mechanism and slider crank mechanism, and study different types of turning moment diagrams and design of flywheels.
2. The knowledge of different types of centrifugal governors, the effects of characteristic parameters and controlling force diagrams for governors, understand the principles of gyroscopic effect and its engineering applications.
3. Understand the balancing of several rotating masses, primary and secondary unbalanced forces in reciprocating engines and ability to analyze single degree freedom systems subjected to free, damped and forced vibrations as well as calculation of critical speeds of shaft under different support conditions.
4. Understand the Basics laws of friction and its engineering applications in pivot and collar bearings, clutches, shoe brake, band and block brakes, and absorption and transmission type dynamometers.

Topics Covered

UNIT-I 9

Static & Dynamic Force Analysis

Static equilibrium of two/three force members, Static equilibrium of member with two forces and torque, Static force analysis of linkages, D'Alembert's principle, Equivalent offset inertia force, Dynamic force analysis of four link mechanism and slider crank mechanism, Dynamically equivalent system

Turning Moment & Flywheel

Engine force analysis-Piston and crank effort, Turning moment on crankshaft, Turning moment diagrams-single cylinder double acting steam engine, four stroke IC engine and multi-cylinder steam engine, Fluctuation of energy, Flywheel and its design

UNIT-II 9

Governors

Terminology, Centrifugal governors-Watt governor, Dead weight governors-Porter & Proell governor, Spring controlled governor-Hartnell governor, Sensitivity, Stability, Hunting, Isochronism, Effort and Power of governor

Gyroscopic Motion

Principles, Gyroscopic torque, Effect of gyroscopic couple on the stability of aero planes & automobiles

UNIT-III 9

Balancing of Machines

Static and dynamic balancing, Balancing of several masses rotating in the same plane and different planes, Balancing of primary and secondary forces in reciprocating engine, Partial balancing of two cylinder locomotives, Variation of tractive force, swaying couple, hammer blow, Balancing of two cylinder in-line engines

Mechanical Vibrations

Types of vibrations, Elements of vibrating system, Classification, Degrees of freedom, Single degree free & damped vibrations of spring-mass system, Logarithmic decrement, Torsional vibration, Forced vibration of single degree system under harmonic excitation, Critical speeds of shaft

UNIT-IV 9

Friction

Laws of friction, Efficiency on inclined plane, Screw friction, Screw jack, Efficiency, Friction in journal bearing-friction circle, Pivots and collar friction-Flat and conical pivot bearing, Flat collar bearing

Clutches, Bakes & Dynamometers

Single and multiple disc friction clutches, Cone clutch, Brakes-types, Single and double shoe brake, Simple and differential Band brake, Band and Block brake, Absorption and transmission dynamometers, Prony brake and rope brake dynamometers

EXPERIMENTS

Minimum Eight experiments are to be conducted from the following

1. Experiments on simple and dead weight governor
2. Experiment on spring controlled governor
3. Experiment on gyroscope
4. Experiment on critical speed of shaft

5. Experiment on longitudinal vibration
6. Experiment on transverse vibration
7. Experiment on static/dynamic balancing
8. Experiment on Gear trains
9. Experiment on Gears tooth profile, interference etc.
10. Study of simple linkage models/mechanisms
11. Study of inversions of four bar linkage
12. Study of inversions of single/double slider crank mechanisms
13. Experiment on Brake
14. Experiment on clutches/dynamometers
15. Experiments on friction

Books & References

1. Theory of Machines - Thomas Bevan (CBS Publication)
2. Theory of Machines and Mechanisms- Shigley (Oxford University Press-New Delhi)
3. Theory of Machines and Mechanisms-Ghosh & Mallik (East West Press)
4. Theory of Machines and Mechanisms- Rao & Dukkipati (Wiley)
5. Theory of Machines - S.S. Rattan (Tata McGraw Hill)
6. Theory of Machines – R.K. Bansal (Laxmi)
7. Mechanics of Machines – V. Ramamurti (Alpha Science Intl Ltd.)
8. Theory of Machines – Khurmi & Gupta (S Chand)
9. Theory of Machines – P.L. Ballaney (Khanna)
10. Theory of Machines – V. P. Singh (Dhanpat Rai publisher)

MEE-354 MANUFACTURING SCIENCE

Course category	:	Department Core (DC)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to understand the fundamentals and analysis of Forging and Rollingprocesses.
2. Knowledge of wire drawing, extrusion, sheet metal working, and unconventional metal forming process such as explosive forming and electromagnetic forming.
3. Know about principles, working and applications of various types of welding processes and their thermodynamic and metallurgical aspects.
4. Able to understand pattern allowances, moulding sand properties, elements of mould and casting processes.

Topics Covered

UNIT-I 9

Introduction

Importance of manufacturing, economic & technological considerations in manufacturing, classification of manufacturing processes, materials & manufacturing processes for common items

Metal forming processes-1

Elastic & plastic deformation. Tresca's & Von Mises' Yield's criteria. Hot & cold working processes. Analysis of forging process for load estimation with sliding friction, sticking friction and mixed condition for slab and disc. Work required for forging. Hand, power & drop Forging. Analysis of Rolling Process. Condition for rolling force and power in rolling. Rolling mills & rolled-sections

UNIT-II 9

Metal forming processes-11

Analysis of Wire/strip drawing and maximum-reduction, Tube drawing, Extrusion and its application. Design, lubrication and defects in metal forming processes.

Sheet metal working:

Presses and their classification Die & punch assembly and press work methods and processes. Cutting/Punching mechanism, Blanking & piercing. Compound & progressive dies. Flat-face & Inclined-face punches and load calculation. Analysis of forming process like cup/deep drawing. Bending & spring-back.

Unconventional metal forming processes

Unconventional metal forming or High Energy Rate Forming (HERF) processes — explosive forming, electromagnetic, electro-hydraulic forming.

UNIT-III 9

Welding: Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes — atomic hydrogen, submerged arc, electroslag, friction. Soldering & Brazing. Thermodynamic and Metallurgical aspects in welding. Shrinkage/residual stress in welds. Defects in welds and their remedies. Weld decay in Heat affected zone (HAZ).

UNIT-IV 9

Casting (Foundry)

Basic principle & survey of casting processes. Types of patterns and allowances. Types and properties of moulding sand, sand testing. Design considerations for elements of mould—Gate, Riser, Runner & Core. Solidification of casting. Sand casting— defects, remedies. Cupola furnace. Other casting processes— Die Casting, Centrifugal casting, Investment casting, Continuous casting and CO_2 casting etc.

Textbooks & Reference books

1. Manufacturing Science -Ghosh and Mallik (EWP)
2. Manufacturing Engineering & Technology- Kalpakjian (Pearson)
3. Materials and Manufacturing - Paul Degarmo. (TMH)
4. Manufacturing Technology – Foundry, Forming and Welding- P. N. Rao (TMH).
5. Manufacturing Processes Vol I – H. S. Shan (Pearson)
6. Fundamental of Modern Manufacturing – M. P. Groover (PHI)

7. Production Engineering Science - P.C. Pandey (Standard publisher)
8. Production Technology - R.K. Jain (Khanna publication)
9. Production Engineering – P. C. Sharma (S. Chand)
10. Workshop Technology Vol1-B. S. Raghubanshi (Dhanpat Rai and Sons)

MEE-366 SEMINAR

Course category	:	Audit Course (AC)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 6
Number of Credits	:	3
Course Assessment methods	:	Continuous assessment through quality of material, presentation, quality & extent of external response of question asked and participation in other seminars (attendance)
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Ability to develop effective writing on recent technological development.
2. Ability to make effective presentation on power point.
3. Ability to comprehend question/answers during presentation.
4. Enhance oral communication skills.

MEE-361 MACHINE DESIGN – II

Course category	:	Department Core (DC)
Pre-requisite Course	:	Mechanics of Solids (MEE-234)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, midterm examination, practical work, record, viva voce and Theory & Practical Examination

1. The ability to deign different types of mechanical spring under static and fatigue loading, and knowledge of different types of screw threads and design of screw jack.
2. The knowledge of tooth forms, gear tooth materials, manufacturing methods and design of spur gear, helical gear and worm gear.
3. The knowledge of different parameters and selection criteria for the sliding contact bearing, rolling contact ball and roller bearing, its lubrication and mountings.
4. The knowledge of design considerations of IC engines parts and design of cylinder head, piston assembly, connecting rod and crankshaft.

Topics covered

UNIT-I 9

Design of Mechanical Springs

Types, Material for helical springs, End connections for compression and tension helical springs, Stresses and deflection of helical springs of circular wire, Design of helical springs subjected to static and fatigue loading.

Power Screws

Forms of threads, multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws, Design of screw jack

UNIT-II 9

Spur Gears

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

Helical and Worm Gears

Terminology, Proportions for helical gears, Beam strength and wear strength of helical gear herringbone gears, crossed helical gears, Design of helical gears.

Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, He dissipation in worm gearing, Strength and wear tooth load for worm gears, Design of wor gearing

UNIT-III 9

Sliding Contact Bearing

Types, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing terminology, Bearing characteristic number, Heat generation, Design of journal bearing, Thrust bearing-pivot and collar bearing, Hydrodynamic thrust bearing,

Rolling Contact Bearing

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

rolling contact bearing, Lubrication of ball and roller bearing, Mounting of bearing

UNIT-IV

IC Engine Parts 9

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

Note: Design data book is allowed in the Minor/Major Examination.

EXPERIMENTS

(i) Minimum Six experiments out of the following are to be performed. Students are advised to use design data book for the design. Drawing shall be made wherever necessary on small drawing sheets

(ii) Mini Project: Students are required to write computer program and validate it for the design of at least two machine components studied in Machine Design-I and Machine Design-II theory subjects as home assignment which is be submitted at the end of the semester.

1. Design and drawing of helical spring subjected to static and fatigue loading
2. Design and drawing of screw jack
3. Generation of gear tooth profile
4. Design of spur gear drive

5. Design of helical gear drive
6. Design of worm and worm wheel
7. Design of journal bearing
8. Design of thrust bearing
9. Selection of ball and roller bearing
10. Design of cylinder and cylinder head
11. Design of piston assembly
12. Design of connecting rod
13. Design of crankshaft

Books & References

1. Mechanical Engineering Design – Joseph E. Shigely (McGraw Hill)
2. Mechanical Design of Machine Components – Norton (Prentice Hall)
3. Fundamentals of Machine Components Design – Juvinall (Wiley)
4. Design of Machine Members-Alex Valance and VI Doughtie (McGraw Hill)
5. Machine design-M.F. Spott (Prentice Hall India)
6. Machine Design-Maleev and Hartman (CBS)
7. Machine design -Black & Adams (McGraw Hill)
8. Machine Design-Sharma and Agrawal (S.K. Kataria & Sons)
7. Design of Machine Elements-V.B. Bhandari (Tata McGraw Hill)

MEE-362 REFRIGERATION & AIR CONDITIONING

Course category : Department Core (DC)

Pre-requisite Course : NIL

Contact hours/week : Lecture : 3, Tutorial : 1 , Practical: 2

Number of Credits : 5

Course Assessment methods : Continuous assessment through tutorials, attendance, home assignments, mid-term examination, practical work, record, viva voce & Practical and theory Examination

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the refrigeration principles, air refrigeration cycles and introduction to the different refrigerants.
2. Understand the knowledge of vapour compression refrigeration system and performance calculations.
3. Understand the knowledge of vapour absorption refrigeration systems and introduction to the psychrometry in air conditioning systems.
4. Understand the designing of air conditioning systems and introduction to various refrigerating equipment and its application.

Topics Covered

UNIT-I 9

Refrigeration

Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P.

Air Refrigeration cycle

Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. **Refrigerants**

Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, secondary refrigerants and CFC free refrigerants

UNIT-II 9

Vapour Compression System

Single stage system, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Different configuration of multistage system, Cascade system.

UNIT-III 9

Vapour Absorption system

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

Air Conditioning-I

Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Thermal analysis of human body, Effective temperature and comfort chart. Cooling and heating load calculations

UNIT-IV 9

Air Conditioning-II

Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP). Introduction to desiccant cooling.

Refrigeration Equipment & Applications

Elementary knowledge of refrigeration & air conditioning equipments, e.g., compressors, condensers, evaporators & expansion devices, Air washers, Cooling, towers & humidifying efficiency, Food preservation, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans.

EXPERIMENTS

Minimum Eight experiments are to be conducted from the following

1. Experiment on refrigeration test rig and calculation of various performance parameters.
2. To study different types of expansion devices used in refrigeration system.
3. To study different types of evaporators used in refrigeration systems.
4. To study Basic components of air-conditioning system.
5. Experiment on air-conditioning test rig & calculation of various performance parameters.

6. To study air washers
7. Study of window air conditioner.
8. Study & determination of volumetric efficiency of compressor.
9. Visit of a central air conditioning plant and its detailed study.
10. Visit of cold-storage and its detailed study.
11. Experiment on Ice-plant.
12. Study of Hermetically sealed compressor

Books & References

1. Refrigeration and Air conditioning - Manohar Prasad (New Age International (P) Ltd)
2. Refrigeration and Air conditioning - C.P Arora (Tata McGraw Hill).
3. Refrigeration and Air conditioning - Arora & Domkundwar (Dhanpat Rai & Co.(p) Ltd, Delhi).
4. Refrigeration and Air conditioning - Stoecker & Jones (McGraw-Hill Education India Pvt.Ltd - New Delhi).
5. Principle of Refrigeration - Roy J. Dossat (Pearson).
6. Refrigeration and Air conditioning - P.L. Baloney (Khanna).
7. Thermal Environment Engineering - Kuhen, Ramsey & Threlkeld (Prentice Hall)
8. Performance studies of desiccant cooling systems - P. Rai, S.K. Shukla (Lambert publication Germany)

MEE-363 IC ENGINES

Course category	:	Department Core (DC)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The importance & Classification of engine such as two & four stroke engines, SI & CI Engines and air standard cycles.
2. The knowledge of SI Engines, configuration & functions; knowledge about carburetor & its type and understand the ignition systems.
3. The knowledge of CI Engines, configuration, functions & fuel injections; Knowledge about knock & its control; knowledge about scavenging in two stroke engines, pollution& its control.
4. The knowledge of cooling systems and lubrication principle and its type in IC engines & also about Supercharging, compressors its type & principle of working.

Topics Covered

UNIT-I 9

Introduction to I C Engines: Engine classification, Air standard cycles, Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles, Sterling cycle, Ericsson cycles, Actual cycle analysis, Two and four stroke engines, SI and CI engines, Valve timing diagram, Rotary engines, stratified charge engine.

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

UNIT-II 9

Testing and Performance of IC engines

Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines. Morse test, heat balance sheet, constant speed / variable speed test

SI Engines

Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and its control, combustion chamber design for SI engines.

Carburetion, Mixture requirements, Carburetor types, Theory of carburetor, MPFI.

Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition.

UNIT-III 9

CI Engines

Combustion in CI engines, Ignition delay, Knock and it's control, Combustion chamber design of CI engines, Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings. Scavenging in two Stroke engines, pollution and its control.

UNIT-IV 9

Engine Cooling: Different cooling systems, Radiators and cooling fans.

Lubrication: Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation.

Supercharging: Effect of altitude on power output, Types of supercharging

Books & References

1. Fundamentals of Internal Combustion Engine - Gill, Smith, Ziurs (Oxford & IBH Publishing Co.)
2. IC Engines – Rogowsky (International Book Co.)
3. Internal Combustion Engine and Air Pollution- E.F Obert (Harper & Row, New York)
4. A Course in International Combustion Engines - Mathur & Sharma (Dhanpat Rai & Sons)
5. I.C Engine – Ganeshan (Tata McGraw Hill)
6. I.C Engine - R. Yadav (Central Publishing House)
7. Turbines, Compressors and Fans - S.M. Yahya (Tata McGraw Hill)
8. Fundamentals of Combustion – D. P. Mishra (PHI Leaning Pvt. Ltd.)

MEE-364 MACHINE TOOLS & MACHINING

Course category	:	Department Core (DC)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, practical work, record, viva voce & Practical and theory Examination

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to understand mechanics of metal cutting, lubricants, tool materials, economics of metal cutting, etc.
2. Study the principles, construction of various parts and working of different machinetools.
3. Able to understand the grinding and super finishing operations and concepts of Standardization & Interchangeability, Limits, Fits & Tolerance and Surface roughness
4. Understand principle and working of different non-conventional machining processes.

Topics Covered

UNIT-I 9

Metal Cutting

Mechanics of metal cutting. Geometry of tool and nomenclature. ASA system. Orthogonal/ Oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces & power required. Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability. Dynamometer. Economics of metal cutting

UNIT-II 9

Machine Tools:

(i) Lathe: Principle, construction, types, operations, Turret/capstan, semi/Automatic, Tool layout.

(ii) Shaper, slotter, planer: Construction, operations & drives.

(iii) Milling: Construction, Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required.

(iv) Drilling, boring & reaming operation tools. Geometry of twist drills. Introduction to machine tool vibration and surface finish.

UNIT-III 9

Grinding & Super finishing

Grinding: Grinding wheels, abrasives (bonds & cutting action). Grinding wheel specification. Wear of grinding wheel— dressing & truing, Max. chip thickness and Guest criteria. Surface and cylindrical grinding. Center less grinding.

Super finishing: Honing, lapping, and polishing.

Jigs & Fixtures

Locating & Clamping devices & principles. Jigs and fixtures and its applications.
Standardization & Interchangeability
Limits, Fits, Tolerance and Surface roughness

UNIT-IV 9

Unconventional Machining

Introduction. Limitations of conventional machining processes, need of Unconventional machining processes & their classifications. Principle, working and applications of Abrasive Jet Machining (AJM),Ultra sonic Machining (USM), Electro discharge machining (EDM), Electrochemical Machining (ECM), & Electron beam machining (EBM)

EXPERIMENTS

Minimum eight experiments are to be conducted from the following:

1. Design and Pattern making
2. Making a mould (with core) and casting.
3. Study & operation of hand & power forging.
4. Press work experiment such as blanking/piercing, washer, making etc.
5. Wire drawing/extrusion on soft material.
6. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine
7. Bolt (thread) making on Lathe machine
8. Gear cutting on milling machine
9. Machining a block on shaper machine
10. Study of different types of tools and its materials
11. Experiment on tool wear and tool life
12. Experiments on welding (Gas, Arc & resistance)
13. Experiment on unconventional machining

Books & References

1. Advanced Machining Process - VK Jain (Allied Publisher)
2. Fundamentals of Metal Cutting & Machine Tools – Juneja & Shekhon (New Age International)
3. Production Technology – P. C. Sharma (S. Chand)
4. Introduction to Machining Science – G. K. Lal (New Age Publisher)
5. Manufacturing Science - Ghosh and Mallik (EWP)
6. Manufacturing Technology : Metal Cutting & Machine Tools- P. N. Rao (TMH)
7. Production Engineering Science - P.C. Pandey (Standard Publisher)
8. Modern Machining Processes - P.C. Pandey & H.S. Shan (TMH)
9. Manufacturing Engineering & Technology- Kalpakjian (Pearson)
10. Production Technology - R.K. Jain (Khanna Publication)
11. Process & Materials of Manufacturing – Roy A. Lindburg (Prentice Hall)
12. Materials and Manufacturing - Paul Degarmo (TMH)
13. Workshop Technology Vol. II-B. S. Raghubanshi (Dhanpat Rai and Sons)

MEE-365 PRINCIPLES OF INDUSTRIAL ENGINEERING

Course category	:	Department Core (DC)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the Concept, Function and Application of industrial engineering, production and productivity, measurement of productivity, work study, work sampling.
2. The knowledge of job evaluation and analysis, wage-incentive payment plans, materials Handling, Objectives and Functions of production planning and control, Break-Even-Analysis.
3. The understanding of depreciation, service life of assets, Inventory control, process control, Control Charts, acceptance plan and acceptance sampling.
4. Understand the Concept and importance of organization, organizational structure, Organizational chart, Sole/proprietary enterprise, labour legislation, factory act, wage and insurance act.

Topics Covered

UNIT-I 9

Introduction

Concept of Industrial Engineering, Function of industrial engineering, Industrial engineering techniques, Role of industrial engineer. Application of industrial engineering

Production and Productivity

Concept of production, production function, production system, definition of productivity, difference between productivity and production, productivity efficiency and effectiveness, measurement of productivity, Types of productivity, productivity index, ways to improve productivity.

Work study

Definition and concept, objectives of work study, purpose and procedure of method study, analysis of motion, micromotion study, motion economy principles, flow chart, man-machine chart, PMTS, work measurement, stop- watch time study, performance rating, standard time, work sampling.

UNIT-II 9

Job Evaluation & Merit rating

Concept of job evaluation, Job analysis, Job description, job simplification, job evaluation methods. Definition and methods of merit rating, wage-incentive payment plans.

Plant layout and materials Handling

Considerations in Plant location, definition of plant layout, types of layout, principles of Plant layout, material handling equipments

Production planning and control

Objectives of PPC, Functions of PPC, production planning, steps in PPC, Effectiveness of PPC system

Break-Even-Analysis

Introduction and purpose of BEA, Margin of safety, Angle of incidence, Profit volume graph.

UNIT-III 9

Depreciation and Replacement

Concept of depreciation, obsolescence, classification of depreciation, method of charging depreciation, service life of assets, Replacement of items.

Inventory Control

Inventory, function of inventory, inventory cost, deterministic inventory models

Statistical Quality Control

Introduction, process control, Control Charts, acceptance plan, acceptance sampling, single, double & sequential sampling plans, concept of average outgoing quality.

UNIT-IV 9

Organization

Concept and importance of organization**,** Principles of organization, organizational structure, Design of organization, Organizational chart.

Industrial Ownership

Sole/proprietary enterprise, partnership firm, Joint stock company, classification of company, comparison of public, private and joint sector, & co-operative organization.

Factory legislation in India

Importance and principles of labour legislation, factory act, payment of wages act, minimum wages act, workmen's compensation act, employee's state insurance act.

Books & References

1. Production Management- S. K. Hajara Choudhary, Nirjhar Roy and A. K. Hajara Choudhary (Media Promoters and Publisher)
2. Production and Operation Management - Adam and Ebert (Pearson Education Asia)
3. Modern Production/operations Management- Buffa (Wiley Eastern, New York).
4. Industrial Engineering and operations management- S.K. Sharma & Savita Sharma (SK Kataria & sons)
5. Industrial Engineering – A.P. Verma (SK Kataria & sons)
6. Industrial Engineering – M.I. Khan (New Age International)
7. Industrial Engineering – S. Seetharaman & B. Vijayaramnath (Umesh Publications)
8. Industrial Engineering and Management – O.P. Khanna (Dhanpat Rai Publications)

BMC-40 PROJECT PART-I

Course category	:	Department Core (DC)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 10
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through three viva voce/presentation, preliminary project report, effort and regularity and end semester presentation
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to apply engineering knowledge of different streams of mechanical engineering to finalize the project statement.
2. To carry out literature review of relevant project problem using textbooks, research papers and internet.
3. To finalize the activities to be carried out to complete the project through bar chart.
4. To plan different activities of project to develop a hardware or computer model

MEE-471 AUTOMOBILE ENGINEERING

Course category	:	Department Core (DC)
Pre-requisite Course	:	IC Engines (MEE-363)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5

Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, practical work, record, viva voce & Practical and theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Good knowledge of automotive components and machineries and Ability to absorb the concerned problem at first instance and provide the suitable remedial measure to the problem.
2. Proficient in designing innovative projects and various transmission systems for fuel efficient engine.
3. Ability to demonstrate the various braking system, chassis and suspension system and electrical systems for automobiles like ignition, horn and battery.
4. Ability to demonstrate the fuel supply, air-conditioning, cooling and lubrication and maintenance systems for automobiles.

Topics Covered

UNIT-I 9

Power Unit and Gear Box

Principles of Design of main components. Valve mechanism. Power and Torque characteristics. Rolling, air and gradient resistance. Tractive effort. Gear Box. Gear ratio determination, Design of Gear box

UNIT-II 9

Transmission System

Requirements. Clutches. Torque converters. Over Drive and free wheel, Universal joint. Differential Gear Mechanism of Rear Axle. Automatic transmission, Steering and Front Axle. Castor Angle, wheel camber & Toe-in, Toe-out etc. Steering geometry. Ackerman mechanism, Understeer and Oversteer.

Vehicle stability- Stability analysis of the Linearlized model of vehicle , stability on a curve

UNIT-III 9

Braking System

General requirements, Road, tyre adhesion, weight transfer, Braking ratio. Mechanical brakes, Hydraulic brakes. Vacuum and air brakes. Thermal aspects.

Chassis and Suspension System

Loads on the frame. Strength and stiffness. Various suspension systems.

Electrical System

Types of starting motors, generator & regulators, lighting system, Ignition system, Horn, Battery etc.

UNIT-IV 9

Fuel Supply System

Diesel & Petrol vehicle system such as Fuel Injection Pump, Injector & Fuel Pump, Carburetor etc. MPFI.

Automobile Air Conditioning

Requirements, Cooling & heating systems

Cooling & Lubrication System

Different type of cooling system and lubrication system

Maintenance system

Preventive maintenance, break down maintenance and over hauling.

EXPERIMENTS

Minimum Eight experiments are to be conducted from the followings:

1. Study & experiment on Ignition system of I.C. Engine.
2. Study & experiment on Fuel Supply System of S.I. Engines- Carburettor, Fuel Injection Pump and MPFI.
3. Study & experiment on Fuel Supply System of C.I. Engines- Injector & Fuel Pump.
4. Study & experiment on Valve mechanism.
5. Study & experiment on Gear Box.
6. Study & experiment on Differential Gear Mechanism of Rear Axle.
7. Study & experiment on Steering Mechanism.
8. Study & experiment on Automobile Braking System.
9. Study & experiment on Chassis and Suspension System.
10. Study & experiment on Air Conditioning System of an Automobile.
11. Comparative study of technical specifications of common small cars (such as Maruti Swift, Hyundai i20, Cheverlet Aveo, Tata Indica, Ford Fusion etc.
12. Comparative study & technical features of common scooters & motorcycles available in India.
13. Visit of an Automobile factory.
14. Visit to a Modern Automobile Workshop.
15. Experiment on Engine Tuning.
16. Experiment on Exhaust Gas Analysis of an I.C. Engine
17. Determination of Indicated H.P. of I.C. Engine by Morse Test
18. Prepare the heat balance for Diesel Engine test rig
19. Prepare the heat balance sheet for Petrol Engine test rig

Books & References

1. Automotive Machines- Hietner (CBS Publisher)
2. Automobile Engineering - Kripal Singh (Standard).
3. Automobile Engineering – Narang (Khanna).
4. Automotive Mechanics- Crouse, Anglin (Career Education)
5. Motor Vehicle – Garrett, Newton and Steeds (Society of Automotive Engineers Inc).

MEE-472 COMPUTER AIDED DESIGN

Course category	:	Department Core (DC)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, practical work, record, viva voce & Practical and theory Examination

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The importance, benefits, applications and essential elements of CAD such as graphics input, display and output devices.
2. The knowledge of graphics software, graphics standards, configuration and functions; skill of writing algorithm for generating 2D graphic elements; and understand the mathematics behind 2D & 3D individual and combined geometric transformations.
3. The ability of mathematical representation of parametric form of analytic planar curves and synthetic space curves such as Hermite, Bezier and B-spline curves and knowledge of their properties.
4. The knowledge of polygonal, quadric and super quadric surfaces, blobby objects, color models and different solid modeling techniques and skill of developing 3D geometric models in CAD software.

Topics Covered

UNIT-I 9

Introduction

Computer in Engineering design, Classical vs. Computer Aided Design, Elements of CAD, Essential requirements of CAD, CAD Tools, Concepts of integrated CAD/CAM, Necessity & benefits, Engineering Applications

Computer Graphics Hardware

Graphics systems, Graphics Input devices-cursor control devices, Digitizers, Image scanner, Speech oriented devices, Graphics display devices-Cathode Ray Tube, Calligraphic display, DVST, Raster display, Color frame buffer, Color CRT monitors, Solid state monitors-emissive displays,
non-emissive displays, Graphics output devices- Hard copy printers and plotters

UNIT-II 9

Computer Graphics Software

Graphics Software, Software Configuration, Coordinate system, Graphics software functions, Viewing transformations-windowing and clipping, Graphics software standards

Output primitives

Scan conversion of primitives, Line generation algorithms-DDA and Bresenham‘s line drawing algorithm, Circle generating algorithm-Cartesian coordinates, Polar coordinates and Bresenham‘s algorithm

Geometric Transformations

2D Geometric transformations-Translation, Scaling, Shearing, Rotation & Reflection Matrix representation-homogeneous coordinates, Rotation and scaling about arbitrary point, Reflection through arbitrary line, Composite transformation, 3 D transformations, multiple transformation

UNIT-III 9

Planar Curves

Curves representation, Interpolation vs approximation, Classical representation of curves, Parametric analytic curves-lines, circles, ellipses, parabolas and hyperbolas

Space Curves

Properties for curve design, Parametric continuity, Parametric representation of synthetic curves, , Spline curves and specifications, Parametric representation of synthetic curves, Hermite curves- Blending functions formulation, shape control, properties, Bezier curves- Blending functions formulation, properties, Non-rational B-spline curves- Blending functions formulation, knot vector, B-spline blending functions, properties

UNIT-IV 9

3D Graphics

Introduction, Wireframe modeling, Surface modeling, Polygon surfaces-polygon meshes, polygon equations, Quadric and Super quadric surfaces, Blobby objects, Solid modeling-Boolean set operations, regularized set operations, Primitive instancing, Sweep representation-translational, rotational and hybrid sweeps, Boundary representation-topology, geometry, boundary models, Constructive solid geometry-unbounded and bounded primitives

Color models

Coloring in computer graphics, RGB, CMY, YIQ, HSV and HLS color models

EXPERIMENTS

Minimum Eight experiments are to be conducted from the followings:

1. Understanding and use of drafting software AutoCAD
2. Sketching and solid modeling of a machine component in any CAD software
3. Sketching and solid modeling of machine assembly in any CAD software
4. Writing and validation of line drawing algorithm
5. Writing and validation of circle drawing algorithm
6. Writing and validation of computer program for individual 2D/3D Geometric Transformation such as translation/ rotation/scaling
7. Writing and validation of computer program for 2D/3D Combined Geometric Transformations
8. Writing and validation of computer program for design of shaft under the combined bending and torsional loading
9. Writing and validation of a computer program for generating planar curves
10. Writing and validation of computer program for generating space curves

Books & References

1. Computer Graphics-Hearn & Baker (Prentice Hall of India)
2. Computer Aided Engineering Design-Anupam Saxena & B. Sahay (Anamaya Publishers)
3. CAD/CAM Theory and Practice- Ibrahim Zeid & R Sivasubramaniam (McGraw Hill)
4. Mathematical Elements for Computer Graphics- DF Rogers & JA Adams (McGraw Hill)
5. CAD/CAM-HP Groover & EW Zimmers, Jr (Prentice Hall India)
6. Computer Aided Design-S.K. Srivastava (IK International Publications)
7. Computer Aided Design-R.K. Srivastava (Umesh Publications)

MEE-481 COMPUTER AIDED MANUFACTURING

Course category : Department Core (DC)
Pre-requisite Course : NIL
Contact hours/week : Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits : 5

Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, practical work, record, viva voce & Practical and theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Ability to understand the role of computer in the areas of automation and manufacturing for improving their effectiveness and fundamentals of CNC machine tools.
2. Ability to develop manual part program and computer assisted part program for the production of components.
3. Ability to design and develop various systems such as feedback, interpolator, material handling and implementation of adaptive control.
4. Ability to apply the concept of group technology and computer assisted process planning and knowledge about Robotics.

Topics Covered

UNIT-I 9

Automation

Need of automation, Basic elements of automation, levels of automation, automation strategies, advantages & disadvantages of automation, historical development and future trends, automated manufacturing system Introduction to computer integrated manufacturing (CAM).

Features of NC Machines

Fundamental of Numerical Control, elements of NC machine tools, classification of NC machine tools, Advantages, suitability and limitations of NC machine tools, Application of NC system, Methods for improving Accuracy considering the factors such as tool deflection and chatter, Methods for improving productivity.

UNIT-II 9

CNC Part Programming

Part programming fundamentals, Manual programming for drilling, turning and milling operations, canned cycles, Do loops, Subroutine, and Macros.

Computer aided part programming, APT programming. Geometry, Motion and additional statements, Macro- statement

UNIT-III 9

System Devices

Introduction to DC motors, stepping motors, feedback devices such as encoder, counting devices, digital to analog converter and vice versa.

Interpolators

Digital differential Integrator-Principle of operation, exponential decelarion, DDA Hardware Interpolator- Linear, Circular; DDA Software Interpolator

Control of NC Systems

Open and closed loops. Control of point to point systems- Incremental open loop control, Incremental close loop, Absolute close loop; Control loop in contouring systems; Adaptive control.

UNIT-IV 9

Computer Integrated Manufacturing system

Group Technology, Flexible Manufacturing System, Computer aided process planning; Concept of Mechatronics, Computer aided Inspection.

Robotics

Types and generations of Robots, Structure and operation of Robot, Robot applications. Economics, Robot programming methods. VAL and AML (with examples)

EXPERIMENTS

Minimum Eight experiments are to be conducted from the followings:

1. To study the characteristics features of CNC lathe trainer.
2. To study the characteristics features of CNC Turning machine.
3. To study the characteristics features of CNC Milling machine.
4. To write Manual part program for a job for turning operation and prepare the component.
5. To prepare Manual part program for a job for drilling operation.
6. To write Manual part program for a job for milling operation and prepare the component.
7. Study of retrofitting.
8. Study of a pick and place robot.
9. Write a program for a pick and place robot to shift the work piece from one location to another.
10. To prepare a part program in APT for drilling operation.
10. To prepare a part program in APT for milling operation.

Books & References

1. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P. Groover (PHI)
2. Computer Aided Manufacturing - P. N. Rao , N. K. Tewari & T. K. Kundra (Tata McGraw Hill).
3. CAD/CAM/CIM – P. Radhakrishnan, S. Subrmanyam and V. Raju (New Age International)
4. Computer Aided Manufacturing – Chang, Wysk and Wang (Pearson)
5. Computer Control of Manufacturing systems – Koren (McGraw Hill)
6. Numerical control and Computer aided manufacturing- - P. N. Rao , N. K. Tewari & T. K. Kundra (Tata McGraw Hill)
7. Computer Aided Design & Manufacture – C. B. Besant & C. W. K. Lui (East West Press)
8. NC Machines – S. J. Martin (English Language Book Society)
9. CAD/CAM – Ibraheim Zeid (Tata McGraw Hill)
10. CAD/CAM- P. N. Rao (Tata McGraw Hill)
11. Principles of Computer Integrated Manufacturing – S. Kant Bajpai (PHI)

MEE-474 INDUSTRIAL / PRACTICAL TRAINING

Course category : Audit Course (AC)
Pre-requisite Course : NIL
Contact hours/week : Lecture : 0, Tutorial : 0 , Practical: 2
Number of Credits : 1

Course Assessment methods	:	Continuous assessment through technical quality of the work, attendance, discipline, involvement and interest, project work, viva voce, project report and presentation
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. An ability to apply knowledge of mathematics, science and engineering in the development of product and process.
2. An ability to design and conduct experiments as well as to analyze and interpret data.
3. An ability to perform multidisciplinary task for the professional development in the field of engineering.
4. Ability to identify sources of hazards, and assess/identify appropriate health & safety measures
5. Ability to demonstrate the use, interpretation and application of an appropriate international engineering standard in a specific situation

MEE-482 PROJECT PART-II

Course category	:	Department Core (DC)
Pre-requisite Course	:	Project Part-I (MEE-473)
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 10
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through three viva voce/presentation, final project report, contribution made to literary world and Major examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to design the various component/subsystem of project using Basic and advanced knowledge of science and engineering subjects.
2. Able to analyze the various components/process of project problem.
3. Able to fabricate the hardware through different fabrication techniques available.
4. Able to make computer programme to design and analyze different components of product.
5. Able to make conclusion of given project.

MPE-471 HYDRAULIC MACHINES

Course category	:	Programme Electives (PE1 & PE2)
Pre-requisite Course	:	Fluid Mechanics (MEE-241)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4

Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Define Basic principles of operation of different types of Hydraulic Turbines and estimate hydrodynamics thrust of jet on fixed and moving plate.
2. Principles, construction, working and design of Francis Turbine and Kaplan Turbines, and its performance characteristics.
3. Classification, Principles, construction, working and design of centrifugal pumps and its performance characteristics.
4. Principles, construction, working of positive displacement reciprocating and rotary pumps and Basic aspects of its design. Principles, construction and working of hydraulic accumulator, hydraulic press, hydraulic lift cranes, hydraulic ram, jet pumps, etc.

Topics Covered

UNIT-I 9

Introduction

Impulse Momentum Principle, Application of momentum and momentum equation to flow through hydraulic machinery, Euler's fundamental equation, Introduction to hydro electric power plants, major components, surge tanks, etc.

Impact of Free Jets

Force exerted by the jet on stationary flat and curved, hinged plate, moving plate and moving curve vanes, effect of inclination of jet with the surface, jet propulsion of ship

Impulse Turbine

Classification of turbines, Impulse turbines, Pelton wheel, Constructional details, Working, Work done, Power and efficiency calculations, Design aspects, Governing of Impulse Turbines

UNIT-II 9

Reaction Turbines

Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Degree of reaction, Draft tube, Cavitations in turbines, Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines, Governing of reaction turbine

UNIT-III 9

Centrifugal Pumps

Classifications of centrifugal pumps, Construction, Working, Work done by impellor, Heads, Efficiencies of centrifugal pumps, Specific speed, Model testing, Multistage pumps, Pump in series and parallel, Performance characteristics. Net positive Section Head, Cavitations and Separation

UNIT-IV 9

Reciprocating Pumps: Classification, Components and Working, Single acting and double acting, Discharge, Work done and power required, Coefficient of discharge and slip, Effect of acceleration of Piston, Indicator Diagram, Air Vessels

Fluid system: Hydraulic accumulator, Hydraulic intensifier, Hydraulic Press, Hydraulic crane, Hydraulic lift, Hydraulic Ram, Hydraulic coupling, Hydraulic torque converter, Air lift pumps, Jet pumps

EXPERIMENTS

Minimum Eight experiments are to be conducted from the followings:

1. Impact of Jet experiment.
2. Conducting experiments and drawing the characteristics curves of Pelton wheel.
3. Conducting experiments and drawing the characteristics curves of Francis turbine.
4. Conducting experiments and drawing the characteristics curves of Kaplan turbine.
5. Conducting experiments and drawing the characteristics curves of Reciprocating pump.
6. Conducting experiments and drawing the characteristics curves of centrifugal pump.
7. Experiment on Hydraulic Jack/Press
8. Experiment on Hydraulic Brake
9. Experiment on Hydraulic Ram
10. Experiment on Compressor
11. Experiment for measurement of drag and lift on aerofoil in wind tunnel
12. Study through detailed visit of any water pumping station/plant

Books & References

1. Mechanics of Fluid – Massey B.S.(English Language Book Society, U.K.)
2. Hydraulic Machines - Jagdish Lal (S.K. Kataria & Sons)
3. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som & G. Biswas (TMH)
4. Hydraulics and Fluid Mechanics – Modi P.N, Seth S.M. (Standard Book House)
5. A Treatise on Applied Hydraulics – Addison (Chapman and Hall)

MPE-472 PRINCIPLES OF MACHINE TOOLS DESIGN

Course category	:	Programme Electives (PE1 & PE2)
Pre-requisite Course	:	Manufacturing Science (MEE-354)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The knowledge of developments in machine tools, construction and operations of Basic machine tools, tool wear and force analysis.
2. Understand the elements of mechanical and hydraulic transmission system, fundamental of kinematic structure of machine tools.
3. Demonstrate an understanding of regulation of speed, feed rates and design of machine tool structure – bed, column and housing.
4. The knowledge of designing guide ways and power screw, dynamic stability of cutting process, machine tool installation and maintenance.

Topics Covered

UNIT-I 9

Introduction

Developments in machine tools, surface profiles and path produced by machine tools, features of construction and operations of Basic machine tools such as lathe, drill, milling, shaper and grinding machine, General requirement of machine tool design & process, tool wear, force analysis.

UNIT-II 9

Machine Tools Drives

Classification of machine tool drives, group & individual drives, selection of electric motor, A brief review of the elements of mechanical transmission such as gear, belt, and chain drives, slider crank mechanism, cam mechanism, nut and screw transmission, devices for intermittent motion, reversing & differential mechanisms, Coupling and clutches. Elements of hydraulic transmission system- pumps, cylinder, directional valves, pressure valves etc. Fundamentals of Kinematic
structure of machine tools

UNIT-III 9

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. Stepless regulation of speed and feed in machine tools.

Design of Machine Tool Structure

Requirements and design criteria for machine tool structures. Selection of material‘s Basic design procedure for machine tool structures—bed, column & housing.

UNIT-IV 9

Design of Guideways and Power Screws

Basic guideway profiles. Designing guideways for stiffness a wear resistance & hydrostatic and antifriction guideways. Design of sliding friction power Screws. Design of spindlier & spindle supports. Layout of bearings, selection of bearings machine tools.

Dynamics of Machine Tools

General procedure for assessing the dynamic stability of cutting process, closed loop system, chatter in machine tools. Machine tool installation and maintenance

Books & References

1. Machine Tools Design & Numerical Controls –N.K. Mehta (Tata McGraw Hill)
2. Design of Machine Tools – S.K. Basu (Allied Publishers)
3. Principles of Machine Tools – A. Bhattacharya and G.C. Sen (New Central book Agency)
4. Machine Tool Design Handbook (CMTI, Bangalore)

MPE-473 PRODUCTION PLANNING & CONTROL

Course category : Programme Electives (PE1 & PE2)
Pre-requisite Course : NIL
Contact hours/week : Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits : 4

Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Know about the characteristics of production systems, objective and functions of Production role of production planning in manufacturing organization, Forecasting and Market Analysis.
2. The understanding of Aggregate Planning, Routing, Scheduling and dispatching, Sheets & charts, Line Balancing.
3. Understand the concept of progress control through records and charts, inventory control, Economic lot (batch) size, Trends in purchasing and store keeping, and JIT production.
4. The Importance of productivity, productivity patterns, measurements & ratios, Human abilities, training & motivation, safety programs, workplace design

Topics Covered

UNIT-I 9

Introduction

Types and characteristics of production systems. Objective and functions of Production, Planning & Control, Role of production planning in manufacturing organization.

Preplanning

Forecasting: characteristics of demand over time, forecasting qualitative model: Delphi, naïve quantitative models: simple average, simple moving average, weighted moving average, exponential smoothing, selection of forecasting models, Market Analysis. Plant Layout, Equipment policy and replacement. Capacity planning.

UNIT-II

Production Planning 9

Aggregate Planning: Concept, strategies for aggregate planning: three pure planning strategies, graphical method for aggregate output planning, master production scheduling (MPS), and procedure for developing MPS. Routing, Scheduling and dispatching. scheduling techniques for job shop, stages in scheduling, load charts and machine loading charts, dynamic sequencing rules, scheduling product –focused systems, scheduling for flexible manufacturing system. Sheets & charts, Line Balancing.

UNIT-III 9

Production and Inventory Control

Progress control through records and charts, Types of inventories, Inventory Classification. Inventory Control under constraints, Economic lot (batch) size. Trends in purchasing and store keeping, JIT production, MRP & MRP II, comparison of Push & Pull systems, ERP, CAPPC.

UNIT-IV 9

Productivity

Importance, Productivity patterns, productivity measurements & ratios, improvement majors.

Human Factors & Ergonomics

Human abilities, training & motivation, safety programs, workplace design.

Books & References

1. Elements of Production Planning & Control –Eilon (Universal Publishing Corporation)
2. Production Planning Control and Industrial Management – Jain and Agrarwal (Khanna Publishers)
3. Modern Production Operations Management – Buffa (John Wiley & Sons Inc)
4. Manufacturing Planning and Control Systems - Vollmann Thomas E, Bery William L (McGraw-Hill)
5. Production Systems – J.L. Riggs (John Wiley and Sons)

MPE-474 INDUSTRIAL TRIBOLOGY

Course category	:	Programme Electives (PE1 & PE2)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the scope of tribology and its applications in manufacturing and machining processes.
2. The knowledge of theory of friction and its mechanisms in metals, ceramics and polymers.
3. The knowledge of wear, its classification, different theories, wear models and its engineering applications.
4. The understanding of lubrication, types of lubricant and their flow, and different lubrication mechanisms.

Topics Covered

UNIT-I 9

Introduction

Definition and Scope of tribology, Contact of solids, Surface topology, Surface interaction.

Applications

Application of tribology in manufacturing processes, Metal machining, Metal cutting, Tool wear, Action of lubricants, Friction welding, Extrusion process

UNIT-II 9

Friction

Definitions, Types, Friction laws, Modern theory of dry solid friction, Mechanism of rolling friction, measurement of friction, friction of metals ceramics and Polymers

UNIT-III 9

Wear

Classifications, wear models, factors affecting wear, Theories of adhesives, Abrasives, Surface fatigue and corrosive wear, Miscellaneous wear theory such as Erosive, cavitations and Fretting wear, Wear of miscellaneous machine components such as gears, Plane bearings and rolling elements.

UNIT-IV 9

Lubrication

Lubrication of bearing, Lubricant, Mineral Oil, Grease, Solid lubricant, Lubrication regime, Viscous flow, Reynolds equation and its limitations, Hydrodynamic lubrication, Hydrostatic lubrication, Elastohydrodynamic lubrication, Boundary lubrication, Squeeze films.

Books & References

1. Engineering Tribology – P Sahoo (Prentice Hall of India)
2. Principles and Applications of Tribology - D.F. Moore (Pergamon Press)
3. Fundamentals of Tribology - Basu, Sengupta & Ahuja (Prentice Hall of India)
4. Friction and Wear of Engineering Materials- I.M. Hutchings (Edwar Arnold, London)
5. Friction and Lubrication- E.P. Bowden and Tabor (Oxford Clarendon Press)
6. Engineering Tribology- Stachowiak & Batchelor (Butterworth-Heinemann)

MPE-475 TOTAL QUALITY MANAGEMENT

Course category	:	Programme Electives (PE1 & PE2)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The understanding of quality concepts, total quality management, development of sources, quality in sales and services, analysis of claims.
2. The knowledge of Organization structure and design, quality function deployment, quality cost, Attitude of top management, operator‘s attitude and responsibility.
3. The understanding of mathematics of control charts, construction and analysis of, R, p and C- charts and use of control charts.
4. The knowledge of Defects diagnosis and prevention, correcting measure, reliability control, maintainability, zero defects, quality circle, ISO-9000, Taguchi method and JIT in some details.

Topics Covered

UNIT-I 9

Quality Concepts

Evolution of Quality control & concept, TQM concept, Quality concept in design, Review of design, Evolution of prototype.

Control on Purchased Product

Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.

Manufacturing Quality

Methods and Techniques for Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.

UNIT-II 9

Quality Management

Organization structure and design, Quality function deployment, Economics of quality value and contribution, Quality cost: Prevention, appraisal, internal failure & external failure costs, optimizing quality & cost reduction programme, use of QM initiatives, tools, and techniques in an organization.

Human factor in quality

Attitude of top management, co-operation of groups, operator‘s attitude & responsibility—causes of operator‘s error and corrective methods.

UNIT-III 9

Control charts

Theory of control charts, construction and use of X bar & R charts, process capability study, use of control charts, Limitations of X bar and R charts.

Attribute control charts

Defects, construction and analysis of using p-chart, effect of variable sample size, construction and use of C-chart.

UNIT-IV 9

Defects Diagnosis and Prevention

Defect study, identification and analysis of defects, corrective measures, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

IS0-9000 and its concept of Quality Management

Introduction, characteristics of quality assurance system. ISO -9000: scope, application, terms & definitions, evolution of ISO-9000 series, ISO 14000 Taguchi method, JIT

Books & References

1. TQM in New Product Manufacturing - Menon, H.G. (McGraw Hill)
2. Total Quality Management - Lt. Gen. H. LaI (Wiley Eastern Limited)
3. Beyond Total Quality Management - Greg Bounds (McGraw Hill)
4. The Management & Control of Quality - Evans & Lindsay (Thompson South-Western).
5. Total Quality Management: Text & Cases - Jankiraman & Gopal (PHI Learning New Delhi).
6. Total Quality Management: A Primer - S M Sundara Raju (Tata McGraw Hill, New Delhi).

7. Introduction to Quality Management and Engineering - Sower, Savoie & Renick (Pearson Education Asia).
8. Total Quality Management - Besterfield Dale H (Pearson Education Asia, Second Edition).
9. Total Quality Management: A Practical Approach - H Lal (New Age International)

MPE-476 ENERGY MANAGEMENT

Course category	:	Programme Electives (PE1 & PE2)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The importance and applications of renewable energy sources their utilization and energy management.
2. Students will be able to apply the 1st and 2nd law of thermodynamics for energy audit performance analysis of different solar systems.
3. The student will be able to convert the electrical energy for comfort of human being in a building and energy audit of combustion process.
4. Student will be able to understand the effect of pollution in environment and government‘s regulation to control them.

Topics Covered

UNIT-I 9

Introduction to energy, Sources of energy, Forms of energy, Energy reserves, renewable energy sources, Unites of energy and the laws of thermodynamics. Definition & objective of energy management, importance, Indian need of energy management, duty and responsibility of energy management. Energy consumption and GDP, energy database, Energy demand analysis, Costs of exploration and utilization of depletable resources, energy pricing, National energy plan.

UNIT-II 9

Energy audit concepts, Energy audit based on 1st law and 2nd law of thermodynamics, Mass and Energy balances, Availability analysis, Evaluation of energy conserving Opportunities, Economic analysis and life cycle costing. Energy conservation areas, Energy transmission and storage, Plant wide energy optimization Models, Database for energy management

UNIT-III 9

Energy conservation through controls, Computer aided energy management, Program organization and methodology. Electrical energy conservation in building lighting, heating, ventilating and air conditioning, Energy efficient motor, power factor improvement in power systems, Energy audit of Combustion process, Boilers, Turbines, compressors, Pumps, Heat exchangers, Condensers, Use of industrial, wastes.

UNIT-IV 9

Energy environment interaction, Environmental issues, Global warning, Carbon dioxide emissions, Depletion of ozone layer, Government's regulations, and Energy economy interaction. Organizing the management: location of energy management, top management support, managerial function, accountability, motivation of employees, marketing and communication, training and planning

Books & References

1. Energy Management and Convention - Clive Beggs, Butterwoth Heinemann (Elsevier Science)
2. Optimising Energy Efficiency in the Industry – Rajan (Tata McGraw Hill)
3. Guide to Energy Management - C.L Capehart (Fairmont Press)
4. Renewable Energy Sources and their Environment Impact - Abbasi & Abbasi (Prentice Hall of India)
5. Environmental Risks and Hazards – Cutter (Prentice Hall of India)
6. Energy and Power Risk Management: New Developments in Modeling, Pricing and Hedging - Alexander Eydeland (John Wiley & Sons)
7. Energy Management Handbook - Wayne C. Turner (John Wiley & Sons Inc).
8. Thermodynamics - Kenneth Wark (Tata McGraw Hill)
9. Exergy Analysis of Thermal, Chemical and Metallurgical Process - Jan Szargut, David R. Morris, Frank R. Steward, Hemisphere Pub (Springer Verlag Publisher)

MPE-477 MECHANICAL VIBRATIONS

Course category	:	Programme Electives (PE1 & PE2)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand different types of vibration and mathematical analysis of single degree freedom system under free vibration and damped vibration.
2. The mathematical analysis of single degree freedom system subjected to forced vibration; understand the principles and working of vibration measuring instruments and able to calculate the critical speeds of shaft.
3. Understand the analysis of two degree freedom system under free, damped and forced vibrations and principle and working of different types of vibration absorbers.
4. The ability to carry out exact and numerical analysis of multi degree freedom system subjected to different types of vibration.

Topics Covered

UNIT-I 9

Introduction

Periodic motion, Harmonic motion, Superposition of simple harmonic motions, Beats, Fourier analysis

Single Degree Freedom System: Free Vibration

Free vibration-spring mass system, torsional system, Natural frequency, Equivalent systems, Energy method for determining natural frequency, Response to an initial disturbance, Phase plane method

Single Degree Freedom System: Damped Vibration

Damping models, Vibrations of spring-mass system with viscous damping, Logarithmic decrement

UNIT-II 9

Single Degree Freedom System: Forced Vibration

Forced vibration, Harmonic excitation with viscous damping, steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Force Transmissibility, Vibration measuring instruments, Displacement, velocity and acceleration measuring instruments

Critical Speed of Shaft

Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed

UNIT-III 9

Two Degree Freedom systems

Introduction, Free vibration-spring-mass system, principal modes, double pendulum, torsional system, Coupled rectilinear and angular modes, Damped Vibration-spring-mass system, Force vibration-spring mass system with harmonic excitation

Vibration absorbers

Introduction, Undamped dynamic vibration absorber, Torsional absorber, Centrifugal pendulum absorber, Dry friction damper

UNIT-IV 9

Multi Degree Freedom system: Exact Analysis

Undamped free and forced vibrations of multi-degree freedom systems, influence number, Maxwell's reciprocal theorem, Torsional vibration of multi-degree rotor system, Principal coordinates, Continuous systems- longitudinal vibrations of bars, torsional vibrations of circular shafts

Multi Degree Freedom system: Numerical Analysis

Rayleigh‘s, Dunkerely's, Holzer's and Stodola methods

Books & References

1. Elements of Vibration Analysis– L. Meirovitch (McGraw-Hill Company)
2. Mechanical Vibrations – P. Srinivasan (Tata McGraw Hill)
3. Mechanical Vibrations – G. K. Grover (Jain Brothers, Roorkee)
4. Mechanical Vibrations – W. T. Thomson (George Allen & Unwin)
5. Theory and Practice of Mechanical Vibrations – J S Rao & K Gupta (New Age International)
6. Mechanical Vibrations – Tse, Morse & Hinkle (CBS Publishers & Distributors Pvt. Ltd)
7. Mechanical Vibrations – V. Rama Murthy (Narosa Publications)
8. Mechanical Vibrations- V. P. Singh (Dhanpat Rai & Co.)

MPE-478 RENEWABLE ENERGY TECHNOLOGIES

Course category	:	Programme Electives (PE1 & PE2)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The importance and applications of renewable energy sources their utilization and collection of solar energy.
2. Student will be able to understand the application of solar energy and wind energy, its conversion, performance analysis of different solar collectors and solar photovoltaic system.
3. The understanding of photosynthesis, bio gas production aerobic and anaerobic bio conversion process, bio gas applications and energy recovery from urban waste and bio mass resource development in India.
4. The knowledge of the fundamentals and application of tidal power, ocean thermal energy, wave energy, geo thermal energy and hydro energy.

Topics Covered

UNIT-I 9

Energy resources

Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy, Hydrogen energy systems, Fuel cells, Decentralized and dispersed generation.

Solar Energy

Sun as Source of Energy, Availability of Solar Energy, Nature of Solar Energy, Solar Energy & Environment. Various Methods of using solar energy –Photothermal, Photovoltaic, Photosynthesis, Present & Future Scope of Solar energy.

Collection of Solar Energy

Solar thermal power and it's conversion, Solar collectors, Flat plate, Performance analysis of flat plate collector, Solar concentrating collectors, Types of concentrating collectors, Thermodynamic limits to concentration, Cylindrical collectors, Thermal analysis of solar collectors, Tracking CPC and solar swing .

UNIT-II 9

Solar Energy Applications

Application of solar energy- Solar water and air heaters, distillation, drying of materials, power generation, cookers, solar refrigeration. Photo voltaic technology.

Wind Energy

Properties of wind, Availability of wind energy in India, wind velocity, Wind machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis wind mills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Wind energy farms, Economic issues,

Recent development.

UNIT-III 9

Bio-mass Energy

Biomass: Generation and utilization, Properties of biomass, Agriculture Crop & Forestry residues used as fuels. Biochemical and Thermo-chemical Conversion, Combustion, Gasification, Biomass gasifiers and types etc., Applications of Gasifiers to thermal power and Engines, Biomass as a decentralized power generation source for villages.

Fuel Cell

Fuel cell – Principle of working, construction and applications

UNIT-IV 9

Geothermal Energy

Geological setting, different geothermal systems, utilization of geothermal energy, its economical and environmental comparison.

Brief description of different utilization techniques for ocean thermal energy, and tidal and wave energy.

Hydel Energy

Hydro power: Potential, Hydropower Generation and Distribution, Mini and Micro-hydel Power (MHP) Generation: Classification of hydel plants, Concept of micro hydel, merits, MHP plants: Components, design and layout, Turbines, efficiency, Status in India.

Books & References

1. Renewable Energy Sources and Conversion Technology - Bansal Keemann, Meliss (Tata McGraw Hill)
2. Renewable Energy Resources and Emerging Technologies - Kothari D.P. (Prentice Hall of India)
3. Nonconventional Energy - Ashok V. Desai (New Age International Publishers Ltd.)

MPE-481 POWER PLANT TECHNOLOGIES

Course category	:	Programme Electives (PE3 & PE4)
Pre-requisite Course	:	Engineering Thermodynamics (MEE-232)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Ability to understand the magnitudes of conventional and renewable energy resources and economics of power plants.
2. Able to understand steam power plant with its components.

3. Able to understand diesel engine power plant and gas turbine power plant with their components.
4. Able to understand nuclear power plant and hydro-electric power plant with their components.

Topics Covered

UNIT-I 9

Introduction Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations.

Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units

Power plant economics and selection Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor‘s profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection

UNIT-II 9

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

UNIT-III 9

Diesel power plant General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant.

Gas turbine power plant Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant

UNIT-IV 9

Nuclear power plant Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection of nuclear power plants.

Hydro electric station Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems.

Books & References

1. Power Plant Engineering - F.T. Morse (Affiliated East-West Press Pvt. Ltd)
2. Power Plant Technology – El Vakil (McGraw Hill)
3. Power Plant Engineering - P.K. Nag (Tata McGraw Hill)
4. Steam & Gas Turbines & Power Plant Engineering - R. Yadav (Central Pub House)

MPE-482 TURBO MACHINERY

Course category	:	Programme Electives (PE3 & PE4)
Pre-requisite Course	:	Engineering Thermodynamics (MEE-232)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Student will be able to understand the working and construction of impulse steam turbine, velocity triangles and designing of blades.
2. Student will be able to understand the working and construction of reaction steam turbine, velocity triangles, degree of reaction and various losses.
3. Student will be able to understand the working and construction of centrifugal and axial flow compressor and their velocity triangles and performance calculations.
4. Students will be able to demonstrate the working of gas turbine plants and efficiency calculations. Further mechanical design consideration followed by turbine blade cooling.

Topics Covered

UNIT-I 9

Impulse Turbines

Steam turbine– Principal of operation of steam turbine, Types, Impulse turbine compounding of steam turbine- pressure compounded velocity compounded and pressure – velocity compounded impulse turbine, Velocity diagram for impulse turbine, Force on the blade and work done, Blade or diagram efficiency, Gross stage efficiency. Influence of ratio of blade to steam speed on blade efficiency in a single stage impulse turbine. Efficiency of multi-stage turbine, Impulse blade sections, Choice of blade angle. Blade height in velocity compounded impulse turbine. State Point Locus and Reheat Factor**,** Governing of steam turbine

UNIT-II 9

Impulse Reaction Turbines

Velocity diagram, Degree of reaction, Impulse-reaction turbine with similar blade section and half degree of reaction (Parson‘s turbine), Height of reaction Turbine blade section, Internal losses in steam turbine Nozzle, Losses, Blade friction losses, Disc friction losses, Blade windage losses or partial admission losses, Gland leakage or clearance losses, Leaving velocity or residual loss, Carry loss.

UNIT-III 9

Centrifugal compressors

Introduction, Classifications of Centrifugal compressors – components, Working, Work done, Velocity Diagrams, Calculations of power and efficiencies, Slip factor, Surging and choking power and Efficiencies, Stage pressure rise, Loading coefficient, Diffuser, degree of reaction, Effect of impeller blade profile, Pre-whirl and inlet guide vanes, Centrifugal Compressor characteristic curves.

Axial flow compressor- Construction, Principle of operation and working, Energy transfer, Velocity Diagram, Factors affecting Stage Pressure Rise, Blockage in Compressor Annulus, Degree of reaction, 3-D flow, Design Process, Blade Design, Calculation of Stage Performance, Axial flow Compressor Characteristic Curves.

UNIT-IV 9

Gas Turbine: Classification of gas turbine, Simple open cycle gas turbine, Ideal and actual cycle (Brayton Cycle) for gas turbine, Optimum pressure ratio for maximum specific output in actual gas turbine, Regeneration, Reheat and inter cooling and effect of these modification on efficiency and output, Closed cycle gas turbine.

Turbine Blade cooling: Different cooling techniques, Types of coolants, Comparative evaluation of different cooling techniques.

Mechanical Design consideration: Overall design choices, Material selection, Design with traditional materials.

Books & References

1. Steam and Gas turbine – By R. Yadav (Central Publishing House)
2. Gas Turbine – V. Ganeshan (TMH)
3. Thermal Turbomachines – Onkar Singh (Wiley India Pvt. Ltd.)
4. Turbine Compressors and Fans – S.M. Yahya (TMH)
5. Turbines, Compressors and fans - S.M. Yahya (Tata McGraw-Hill)
6. Gas turbine theory - Cohen & Rogers, Addison Weslay (Longman Ltd.)
3. Design of high efficiency turbomachinery and gas turbines - David Gordon (Wilson)

MPE-483 PROJECT MANAGEMENT

Course category	:	Programme Electives (PE3 & PE4)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Knowledge of various phases of project management.
2. Knowledge of structure of different types of organization and its selection.
3. Know about project appraisal and cost estimation.
4. Understand the various aspects of CPM and PERT and their implementation in Project.

Topics Covered

UNIT-I 9

Project Management Concepts: Introduction, project characteristics, taxonomy of projects, project identification and formulation. Establishing the project and goals, Nature & context of project management; phases of PM, A framework for PM issues, PM as a conversion process, project environment & complexity, Organizing human resources, organizing systems & procedures
for implementation

UNIT-II 9

Project Organization & Project Contracts: Introduction, functional organization, project organization, matrix organization, modified matrix organization, pure project organization, selection of project organization structure, project breakdown structures, project contracts, types of contracts, types of payments to contractors.

UNIT-III 9

Project Appraisal & Cost Estimation: Introduction, technical appraisal, commercial appraisal, economic appraisal, financial appraisal, management appraisal, social cost/benefit analysis, project risk analysis, Cost analysis of the project, components of capital cost of a project, modern approach to project performance analysis.

UNIT-IV 9

Project Planning & Scheduling: Introduction to PERT & CPM, planning and scheduling networks, time estimation, determination of critical path, CPM model, slacks & floats, PERT model, , PERT & CPM cost accounting systems, lowest cost schedule, crashing of networks, linear programming formulation of event oriented networks, updating of networks, LOB technique, Complexity of project scheduling with limited resources.

Books & References

1. Project Management - K. Nagarajan (New Age International)
2. Operation Research for Executive – L. S. Srinath (EWP)
3. Guide to the Project Management Body of Knowledge - Project Management Institute (Project Management Inst)
4. Project Management - Greer Michael (Jaico Publications)
5. Successful Project Management - Trevor Young (Kogan page)

MPE-484 ADVANCED WELDING TECHNOLOGY

Course category	:	Programme Electives (PE3 & PE4)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the importance and application of welding, conventional welding, weld design and inspection/testing.
2. Develop good knowledge about Thermal and Metallurgical consideration of welding, HAZ, automation and safety in welding.
3. Student will have through knowledge about plasma arc, laser beam, electron beam, ultrasonic and diffusion welding.
4. Develop good knowledge about explosive welding, underwater welding, metal spraying and surfacing.

Topics Covered

UNIT-I 9

Introduction

Importance and application of welding, problems and drawbacks associated with conventional welding processes, Selection of welding process, Brief review of conventional welding process

Weld Design

Welding machines/equipments and its characteristics, Heat input and heat flow, Weld defects and distortion, Inspection/testing of welds, Life prediction

UNIT-II 9

Thermal and Metallurgical considerations

Thermal considerations for welding, temperature distribution, Analytical/Empirical analysis/formulae, heating & cooling, curves. Metallurgical consideration of weld, HAZ and Parent metal, micro & macro structure. Solidification of weld and properties Automation in welding, Economics of Welding, Safety in welding

UNIT-III 9

Advanced welding Techniques-1

Principle, equipment, working and applications of Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding and Diffusion welding

UNIT-IV 9

Advanced welding Techniques-2

Principle, equipments, working and applications of explosive welding/ cladding, underwater welding, metal spraying and surfacing.

Books & References

1. Welding Processes and Technology – Dr. R. S. Parmar (Khanna Publication)
2. Manufacturing technology – Foundry, Forming and Welding- P. N. Rao (Tata McGraw Hill).
3. Welding and Welding Technology – Richard L. Little (Tata McGraw Hill).
4. Workshop Technology Vol1-B. S. Raghuvanshi (Dhanpat Rai and Sons)

MPE-485 ADVANCED MANUFACTURING TECHNOLOGY

Course category	:	Programme Electives (PE3 & PE4)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the need of unconventional manufacturing processes and familiar with abrasive water jet cutting and machining process.
2. Knowledge of working principle, advantages, limitations and applications of Electro-chemical Machining, Electric Discharge machine and chemical machining. Understand working, effect of process variables and applications of Laser beam machining, Electron beam machining, Ultrasonic machining, Plasma arc machining.
3. Knowledge High energy forming processes, and Diffusion and Photo- Lithography process.

Topics Covered

UNIT-I 9

Introduction

Limitations of conventional manufacturing processes, need of unconventional manufacturing processes & its classification and its future possibilities.

Water Jet Cutting (WJC): WJC machine, Process characteristics and application.

Abrasive Jet machining: Machining setup, parametric analysis and applications.

Abrasive Water Jet machining: Working principle, process variables, Cutting parameters and process capabilities.

UNIT-II 9

Advanced Machining Processes-1

Working principle, machine/equipment, process variables, advantages, limitations and applications of Electro-Discharge machining (EDM), Electrochemical machining (ECM), Chemical machining (CM), Electro chemical grinding and Electro discharge grinding.

UNIT-III 9

Advanced Machining Processes-2

Working principle, machine/equipment, process variables, advantages, limitations and applications of Laser beam machining (LBM), Electron beam machining (EBM), Ultrasonic machining (USM), Plasma arc machining (PAM)

UNIT-IV 9

Unconventional Forming processes

Principle, working and applications of High energy forming processes such as Explosive Forming, Electromagnetic forming, Electro discharge forming, water hammer forming, explosive compaction etc.

Electronic-device Manufacturing

Brief description of Diffusion and Photo- Lithography process for electronic-device manufacturing

Books & References

1. Advanced Machining Processes– Vijay K. Jain (Allied Publishers Pvt Ltd.)
2. Modern Machining Process- Pandey and Shan (Tata McGraw Hill).
3. Non-Conventional Machining – P.K. Mishra (Narosa Publishing House).
4. Non Traditional Manufacturing Process – Gary F. Benedict (Marcel Dekker)
5. Machining Process :Conventional and Non-Conventional Process-Hassan Abdel-Gawad El-Holy (CRC Press –Taylor and Francis)

MPE-486 ADVANCED ENGINEERING MATERIALS

Course category	:	Programme Electives (PE3 & PE4)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To understand the Basic structures, atomic bonding, and importance of materials for different applications.
2. To understand the surface behavior of materials with their phase diagrams.
3. The knowledge of ferrous and nonferrous materials with the inclusion of advanced materials.
4. The knowledge and applications of Mechanical and thermal behavior of different materials.

Topics Covered

UNIT-I 9

Introduction

Brief history of engineering materials, Importance of materials, Classification of Materials, Engineering Materials, Advanced Materials and Future Materials

Crystallography

Atomic Structure, Atomic Bonding in Solids, Bravais Lattices, Crystal Structures, Crystalline, Quasi Crystalline and Non-Crystalline Materials, Miller Indices, Miller-Bravais Indices for Planes and Directions of Cubic and Non-Cubic Structures.

UNIT-II 9

Structural Analysis of Materials

Microstructural phenomenon for different materials, Diffusion Mechanisms, Fick‘s Laws, Steady & Non-steady State Diffusion, Scanning Electron Microscope (SEM), Atomic Force Microscope (AFM).

Phase Diagrams

Phase Rule, Equilibrium Phase Diagrams, Phase Systems. Iron-Carbon Phase Diagram, TTT Diagram Imperfections in Solids, Recovery, Recrystallization and Grain Growth, Mechanisms of Strengthening, Solid Solution Strengthening.

UNIT-III 9

Ferrous &Non ferrous alloys

Ferrous Alloys: Low Alloy and High Alloy Steels, Tool Steels, Stainless Steels, Cast irons etc. Non-ferrous alloys: Copper and its alloys, Aluminum and its alloys, Nickel, Zinc, Shape Memory Phenomenon and Alloys; Ceramics, Cermets, Glass and Carbon Products; Failure Prevention; and The Selection Process.

Advanced Materials

Composite materials, Nano materials, Smart materials, Optical materials etc.

UNIT-IV 9

Mechanical Behavior of Materials

Study about Stress strain diagram for brittle & Ductile materials (Mild steel), elastic constants, work hardening ,Hot and cold working, Fracture, Ductile and Brittle Fracture, Griffith's theory of brittle fracture, Ductile-Brittle Transition, Stress Intensity Factor (SIF), Hardness, Impact Testing, Bending, Fatigue, Creep etc.

Thermo-Mechanical Behavior of Materials

Thermo-gravimetric analysis (TGA), Dynamic mechanical analysis (DMA), Thermal conductivity etc.

Books & References

1. A Materials and processing approach - G.E. Dieter (McGraw Hill)
2. Materials selection in Mechanical Design- M.F Ashby (Pergamon press)
3. Engineering Materials Properties and Selection - Kenneth G. Budinski (Prentice Hall of India)
4. Engineering Metallurgy Part 1- R.A. Higgins (Edward Arnold)
5. Selection of Engineering Materials- Gladius Lewis (Prentice-Hall)

MPE-487 ADVANCED MECHANICS OF SOLIDS

Course category	:	Programme Electives (PE3 & PE4)
Pre-requisite Course	:	Mechanics of Solids (MEE-234)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understanding and application of three dimensional stress and strain, principal stresses and principal strains, Mohr circle.
2. Understanding of generalized Hooke's law, relation between elastic constants, equations of equilibrium and determination of stresses & deflection due to unsymmetrical bending.
3. Determine stresses due to rotation of uniform and variable thicknesses of solid disc, rotating shafts and cylinders. Design of thick cylindrical shell and compound cylinders subjected to internal and external pressure.
4. Determine stresses in curved beams such as crane hooks and circular ring under tension and compression. Torsional stresses of prismatic, circular, elliptical bars and thin walled tubes & rolled section.

Topics Covered

UNIT-I 9

Analysis of Stress and Strain

Stress at a point and state of stress, Stress and Strain tensor, Principal stresses and principal planes, Stress invariants, Mohr‘s stress circle for 3D state of stress, Planes of maximum shear, Octahedral stresses, State of pure shear, Plane state of stress, Differential equations of equilibrium

Analysis of strain

Introduction, Deformations, Deformation in the neighborhood of a point, State of strain at a point, Shear strain components, Cubical dilatation, Principal axes of strain and principal strains, Plane state of strain, Compatibility conditions.

UNIT-II 9

Stress Strain relations for Linearly Elastic Solids

Generalized statement of Hooke‘s law, Stress-strain relationships for isotropic materials, Modulus of rigidity, Bulk Modulus, Young‘s modulus and Poisson‘s ratio, Relation between the elastic constants, Displacement equations of equilibrium, Thermo elastic stress-strain relations

Unsymmetrical bending and Shear centre

Stresses due to unsymmetrical bending, Deflection of beams due to unsymmetrical bending, Determination of shear centre and flexural axis for I-section and channel section

UNIT-III 9

Stresses in Axi-symmetric Bodies due to Rotation

Stresses due to rotation of solid discs of uniform thickness and disc with a hole, Disc of variable thickness, Rotating shafts and cylinders

Thick cylindrical shell

Stresses in thick cylinders subjected to internal or external pressures, Design of thick cylindrical shell, Compound cylinders, Stresses due to interference fits

UNIT-IV 9

Curved Beams

Bending of beams with large initial curvature, Position of neutral axis for rectangular, circular, triangular and trapezoidal cross-sections, Stresses in crane hooks and circular rings under tension and compression

Torsion of Non Circular Bars

Torsion of Prismatic, circular and elliptical bars, Torsion of rectangular bars, Torsion of thin walled tubes, Torsion of rolled sections

Books & References

1. Advanced Mechanics of Materials - P. Boresi (Wiley)
2. Mechanics of Materials – Popov (Pearson US Imports & PHIPEs)
3. Advanced Mechanics of Solids-L S Srinath (Tata McGraw Hill)
4. Mechanics of materials-Pytel (CL Engineering)
5. Strength of Materials-Ryder (Mcmillan Publishers India Limited)
6. Strength of Materials-Timoshenko and Young (Tata McGraw Hill)
7. Strength of Materials-S. Ramamurtham (Dhanpat Rai Publishing Co.)
8. Strength of Materials-R. K. Rajput (S. Chand)
9. Strength of Materials–R. K. Bansal (Lakshmi Publications)

MPE-488 GAS DYNAMICS AND PROPULSION

Course category	:	Programme Electives (PE3 & PE4)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Student will understand the concept of gas dynamics, fundamental equations and isentropic flow.
2. Ability to get the knowledge of compressible flows and pertaining calculations.
3. Student will be able to demonstrate the wave phenomena and make calculations for variable flow area like nozzle design pressure and efficiency.
4. Able to understand and demonstrate the basics of jet propulsion, various jet propulsion engines and their efficiency calculations.

Topics Covered

UNIT-I 9

Concept of Gas Dynamics

Introduction, Applications

Fundamental Equations of Steady Flow

Introduction, Assumption, Equation of Continuity, Control Volume, Momentum Equation, Bernoulli‘s Equation, Steady Flow Energy Equation.

Isentropic Flow

Introduction, Acoustic Velocity, Flow from a Reservoir, Flow Parameters

UNIT-II 9

Diabetic Flow

Introduction, Stagnation Temperature, Rayleigh Line, Pressure Ratio, Temperature Ratio.

Flow with Frication and No Heat Transfer Adiabatic Flow

Introduction, Frication Loss, The Fanning Equation, Frication Factor, Fannoline.

UNIT-III 9

Wave Phenomena

Introduction, Normal Shock Waves, Oblique Shocks.

Variable Area Flow

Introduction, Velocity, Criteria for Acceleration and Deceleration, Effect of Back Pressure on Nozzle Flow, Over-expanding and Under-expanding Nozzles, Design Pressure, Nozzle Efficiency.

UNIT-IV 9

Jet Propulsion

Introduction, Types, Pulse jet, Ram jet, Turbo-jet, Efficiency and Horse Power of Propulsion, Flying Unit.

Books & References

1. The Dynamics and Thermodynamics of Compressible Fluid Flow, Vol. I – Shapiro (Ronald Press Co.)
2. Gas Dynamics - Cambel and Jennings (McGraw Hill)
3. Elements of Gas Dynamics – Mattingly (Tata McGraw-Hill Education)
4. Fundamental of gas dynamics – Zucker, and Biblarz (John Wiley & Sons, Inc)
5. Dynamics of compressible flow- Yahya (New Age Publishers, Delhi)

Audit Courses for B.Tech. (Mechanical Engineering)
Year I

BSH-117 ENVIRONMENTAL CHEMISTRY

Course category	:	Basic Sciences & Maths (BSM)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Students will acquire basic knowledge about environment, which allows students to gain qualitative and quantitative skills.
2. Students will aware of environmental pollution and control methods along with quality standards of air, water etc along with waste management.
3. Students will able to give systematic account of natural resources their use of exploitation and environmental
4. Students will acquire basic knowledge about the chemical reactions taking place in the environment.

Topics Covered

UNIT-I 9

Basic concept of Environmental chemistry, Introduction to atmospheric chemistry, Layers of the atmosphere and their chemical composition, chemistry of gaseous and particulate pollutants, , Stratospheric ozone depletion, Ozone Holes , stratospheric ozone chemistry , Fossil fuel burning, CO_2 emissions, Greenhouse Effect Troposphere air pollution, concept of fog and smog, Consequences of air pollution. The Human Health Effects of Outdoor Air Pollutants

UNIT-II 9

The Chemistry of Natural Waters , Oxidation-Reduction Chemistry in Natural Waters, Ion Concentrations in Natural Waters and Drinking Water, Water Pollution and Purification of Water, Water Disinfection , Desalination of Salty Water, Groundwater: Its Supply, Chemical Contamination, and Remediation The Chemical Contamination and Treatment of Wastewater and Sewage .Management of water resources.

UNIT-III 9

Toxic Heavy Metals, Mercury, Lead, Arsenic and chromium, Soil pollution, Domestic and Commercial Garbage: Its Disposal and Minimization. The Recycling of Household and Commercial Waste, Hazardous Wastes and methods of disposal

UNIT-IV 9

Toxic Organic Compounds, Pesticides, Insecticides, Herbicides, Dioxins, Furans, and PCBs, Polynuclear Aromatic Hydrocarbons Chemistry of food additives, dyes, detergents and bleaching agents

Books & References

1. Environmental Chemistry - Colin Baird and Michael Cann, W. H. Freeman
2. Environmental Chemistry - Stanley E. Manahan, CRC Press; 9th edition

BSH-118 ENVIRONMENT & ECOLOGY

Course category	:	Basic Sciences & Maths (BSM)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Students will acquire basic knowledge in Environment and Ecology, which allows students to gain qualitative and quantitative skills.
2. Students will aware of environmental pollution and control methods along with quality standards of air, water etc along with waste management.
3. Students will able to give systematic account of natural resources uses and their exploitation.
4. How to achieve sustainable development through strategies and its threats.

Topics Covered

UNIT-I 6

The Multidisciplinary nature of environmental studies, Definition, scope and importance, Need for public awareness. Natural Resources, Renewable and non-renewable resources, Natural resources and associated problems

(a) Forest resources: Use and over-exploitation, deforestation, Timber extraction, mining.

(b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

(c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources,

(d) Food resources: World food problem, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

(e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources.

UNIT-II 6

Ecosystems

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids

Introduction, types, characteristic features, structure and function of the following ecosystem: (a) Forest ecosystem (b) Grassland Ecosystem (c) Aquatic ecosystems (ponds, rivers, oceans)

Biodiversity

Introduction- Definition : genetic, species and ecosystem diversity, Biogeographically classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National and local levels, India as a mega-diversity nation, Hot-spots of biodiversity, Threats to biodiversity: habitat loss, Endangered and endemic species of India, Conservation of biodiversity:

UNIT-III 6

Environmental Pollution Causes, effects and control measures of- (a) Air Pollution. (b) Water Pollution. (c) Soli Pollution (d) Marine Pollution. (e) Noise Pollution. (f) Thermal Pollution.

Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution

Global warming and green house effect, Acid Rain, Ozone Layer depletion

UNIT-IV 6

Environmental Protection- Role of Government, Legal aspects, Initiatives by Non-governmental Organizations (NGO), Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public awareness.

Human Population and the Environment Population growth, Population explosion- Family Welfare Programme, Environment and human health, Environmental Education, Women Education., Women and Child Welfare

Books & References

1. Environmental Studies - J Krishnaswamy , R J Ranjit Daniels, Wiley India
2. Environmental Science - Bernard J. Nebel, Richard T. Right, 9780132854467, Prentice Hall
3. Environment and Ecology - R K Khandal, 978-81-265-4277-2, Wiley India
4. Environmental Science – 8th edition ISV, Botkin and Keller, 9788126534142, Wiley India
5. Environmental Studies - Soli. J Arceivala, Shyam, R Asolekar, McGrawHill India, 2012
6. Environmental Studies - D.L. Manjunath, 9788131709122 Pearson Education India, 2007

ECE-121 FUNDAMENTALS OF ELECTRONICS ENGINEERING

Course category : Engineering Fundamentals (EF)
Pre-requisite Course : NIL
Contact hours/week : Lecture : 3, Tutorial : 0 , Practical: 2

Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, Midterm, practical work, record, viva voce & Practical and theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to identify schematic symbols and understand the working principles of electronic devices, e.g., Diode, Zener Diode, LED, BJT, JFET and MOSFET etc.
2. Able to understand the working principles of electronic circuits e.g. Rectifiers, Clipper, Clamper, Filters, Amplifiers and Operational Amplifiers etc. also understand methods to analyse and characterize these circuits
3. Able to understand the functioning and purposes of Power Supplies, Test and Measuring equipments such as multimeters, CROs and function generators etc.
4. Able to rig up and test small electronics circuits.

Topics Covered

UNIT-I 9

Semiconductor materials and properties: electron-hole concepts, Basic concepts of energy bands in materials, concept of forbidden gap, Intrinsic and extrinsic semiconductors, donors and acceptors impurities, Junction diode, p-n junction, depletion layer, v-i characteristics, diode resistance, capacitance, diode ratings (average current, repetitive peak current, non-repetitive current, peak- inverse voltage). Diode Applications in rectifier, filters, voltage multipliers, load regulators, clipper and clamper circuits, Breakdown mechanism (Zener and avalanche), breakdown characteristics, Zener resistance, Zener diode ratings, Zener diode application as shunt regulator

UNIT-II 9

Transistors(BJT and FET);Basic construction, transistor action, CB, CE and CC configurations, input/output characteristics, Biasing of transistors-fixed bias, emitter bias, potential divider bias, comparison of biasing circuits. Transistor Amplifier: Graphical analysis of CE amplifier, concept of voltage gain, current gain, h- parameter model (low frequency), computation of Ai, Av, Ri, Ro of single transistor CE and CC amplifier configurations. Field Effect Transistors(JFET and MOSFET): Basic construction, transistor action, concept of pinch off, maximum drain saturation current, input and transfer characteristics, characteristic equation CG, CS and CD configurations, fixed & self-biasing.

MOSFET: depletion and enhancement type MOSFET-construction, operation and characteristics. Computation of Av, Ri, Ro , of single FET amplifiers using all the three configurations

UNIT-III 9

Switching theory and logic design: Number systems, conversion of bases, Boolean algebra, logic gates, concept of universal gate, canonical forms, Minimization using K-map

Operational Amplifiers

Concept of ideal operational amplifiers, ideal op-amp parameters, inverting, non-inverting and unity gain amplifiers, adders, difference amplifiers, integrators

UNIT-IV 9

Electronics Instruments: Working principle of digital voltmeter, digital multimeter (block diagram approach), CRO (its working with block diagram), measurement of voltage, current, phase and frequency using CRO

EXPERIMENTS

Note: Minimum Eight experiments are to be performed

1. To Plot the forward/Reverse Characteristics of Si P-N junction diode.
2. To Plot the forward/Reverse Characteristics of Zener diode
3. Study and plot the characteristic of Zener diode as voltage regulator
4. Study of half wave rectifier and draw the nature of input / output signal. Calculate the value of I_{dc}, I_{rms} and ripple factor.
5. Study of Full wave rectifier and draw the nature of input / output signal. Calculate the value of I_{dc}, I_{rms} and ripple factor.
6. Study of Bridge Rectifier and draw the nature of input / output signal. Calculate the value of I_{dc}, I_{rms} and ripple factor.
7. Draw input output characteristic curve of n-p-n transistor in CE configuration
8. Draw input output characteristic curve of n-p-n transistor in CB configuration
9. Draw the drain and transfer curve of JFET
10. Study of OP-AMP (741) and calculate the gain in (i) Inverting mode and (ii) Non inverting mode
11. Study of OP-AMP as a (i) Summer (ii) Integrator (iii) Differentiator; and plot the nature of input & output waveform
12. Study of CRO and multi-meter measurement voltage, frequency, phase difference using CRO along with the testing of electronics component

Books & References

1. Electronic Devices and Circuits-Boylestad and Nashelsky, 6e, PHI, 2001
2. Electronic Devices and Circuits, A Mottershead, PHI,2000, 6e
3. Digital Computer Design, Morris Mano, PHI,2003
4. Electronic Instrumentation-H.S. Kalsi, 2e,TMH, 2007

BSH-124 SPACE SCIENCE

Course category	:	Basic Sciences & Maths (BSM)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Breadth and depth of knowledge in Space Science subject.
2. Students will find a useful place for applying their engineering knowledge and skills in the domain of Space Science and broadly saying astrophysics.
3. Group learning and problem solving.
4. The tools and techniques which can help them to peep into the Universe and fiddle the riddles there in.

Topics Covered

UNIT-I 6

Observational Astronomy: Introduction ancient age astronomy and the scientific revolution of Copernicus and Galileo, Astronomical techniques: Telescope, its construction, functioning, resolving and its light gathering power, Use of balloon for observations on earth, Requirement of rocket and satellite technology, Charge Couple Device (CCD) as an optical detection system, An overview of Radio, infrared, microwave, ultra-violet, X-rays & γ –rays telescope with specific examples and their pioneering breakthroughs, An overview of near earth and space explorations using satellite, robotic and manned missions, Gravitational red shift by sun, clock rates in satellites, Gravitational lensing, Perihelion motion of mercury, Importance of observational astronomy and telecommunication.

UNIT-II 6

Our Solar System: Origin of our solar system, Sun and its theoretical model, Energy production inside stars: proton-proton chain & CNO cycle, Sun's chromosphere, Solar storm and the solar wind, Neutrinos from Sun, The description of eight planets and their moons with their atmospheric and geographical conditions & vital statistics, Removal of Pluto from the list of nine planets, Classification of planets, The green house effect, Existence in favor water in remote past of mars, Other planetary bodies: Asteroids, comets and meteorites, The cosmic dust, Oort cloud and the Kuiper's belt, The great comet crash: Shoemaker-Levy, Types of asteroids and their properties, The direct and indirect spectroscopy. Titus-Bode law, Keplar's laws of planetary motion, Newton's law of gravitation from Keplar's law of planetary motion

UNIT-III 6

(a) **Stars and their classification:** Harvard classification of stars, Morgan-Keenan system, spectral classification of stars, The Hertzsprung-Russel diagram: main sequence stars, red and super-red giants, dwarf stars and black holes, Sun's evolution in H-R diagram, The Schwarzchild solution: massive stars, singularity and the black holes, Loss of information from a black hole, Accretion of mass and emission of jets in a binary star system: neutron star, black hole, Theory of compact stars: White dwarf stars and neutron stars; their evolution and equilibrium.

(b) **Large celestial bodies:** Our galaxy, Types of galaxies: Elliptical, Spiral and SO type of galaxies, Irregular galaxies, their morphology, evolution and contents, Hubble's tuning fork diagram, Cluster of galaxies and their evolution, Collision and merger of galaxies, Active galaxies: Exploding galaxies, Seyfert galaxies, Quasars and pulsars etc.

UNIT-IV 6

The Big-Bang Theory: The expanding universe: Hubble's law and constant, The flaw in Hubble's measurement, The hot big-bang model: arguments in its favor and against, The evolution of the universe after big-bang: description of different phases, matter, energy and forces, Models of the Universe: the closed, open and flat models and their relevance with observations, Origin of various bands of electromagnetic bands of spectrum in Universe, COBE: black body spectrum of the Universe, The existence of dark matter and dark energy: composition, Role of dark matter and dark energy in evolution of Universe, Cosmic rays, Creation of mass and the God particle.

Books & References

1. Introduction to Cosmology- J. V. Narlikar, Cambridge University Press
2. Introduction to Special Relativity and Space Science - Satya Pal Singh, Wiley India Pvt. Ltd., New Delhi
3. Observational Astronomy - D. Scott Birney, Guillermo Gonzalez and David Oesper, Cambridge University Press.
4. Observational Astronomy: Technique and Instrumentation - Edmund C Sutton, Cambridge University Press
5. 100 Billion Suns: The Birth, Life and Death of Stars - Kippenhahn R, Weidenfeld and Nicolson

Year II

BSH-232 NANOTECHNOLOGY

Course category	:	Basic Sciences & Maths (BSM)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Will be able to demonstrate breadth and depth of knowledge in nanoscience and nanotechnology.
2. The effect of dimensionality and size on material properties.
3. The tools and techniques which can help them to experimentally observe nanomaterials.
4. They can explore the material world with their advance possible applications in making devices and sophisticated instruments.
5. They can find the vital role of this emerging area across various engineering disciplines.

Topics Covered

UNIT-I 6

Introduction

Definition of Nanoscience and Nanotechnology, Applications of Nanotechnology.

Introduction to Physics of Solid State

Structure: Size dependence of properties; crystal structures, Face Centered Cubic (FCC) and Hexagonal Closed Packing (HCP) nanoparticles; Tetrahedrally bounded semiconductor structures; lattice vibrations.

Energy Bands

Insulators, semiconductor and conductors; Reciprocal space; Energy bands and gaps of semiconductors.

UNIT-II 6

Quantum Theory For Nanoscience

Time dependent and time independent Schrodinger wave equations. Particle in a box, Potential step, Overview of Reflection and tunneling, Penetration of Barrier, Electron trapped in 2D plane sheet, Quantum confinement effect in nanomaterials.

Quantum Wells, Wires and Dots

Preparation of Quantum Nanostructure; Size and Dimensionality effect.

UNIT-III 6

Growth Techniques of Nanomaterials

Lithographic and Non-lithographic techniques, Sputtering and film deposition in glow discharge, DC sputtering technique. Thermal evaporation technique, E-beam evaporation, Chemical Vapour Deposition (CVD), Pulsed Laser Deposition, Molecular beam Epitaxy, Sol-Gel Technique (No chemistry required), Electro-deposition, Chemical bath deposition, Ion beam deposition system.

Some Important Nanostructures

Bucky Ball, Carbon nanotubes, synthesis, properties and their applications.

UNIT-IV 6

Tools for Characterization of Nanomaterials

Structure: Crystallography, particle size determination, surface structure.

Microscopy: Scanning Probe Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy (TEM).

Books & References

1. Introduction to Nanotechnology - C.P. Poole Jr and F.J. Owens, Wiley India, New Delhi
2. Nano Materials - A.K. Bandyopadhyay, New Age International
3. Microcluster Physics - S. Sugano & H. Koizuoni, Springor 1998
4. Handbook of Nanostructured Materials & Nanotechnology‖ vol.-5, Academic Press, 2000

EEE- 231 ELECTROMECHANICAL ENRGY CONVERSION

Course category	:	Audit Course
Pre-requisite Course	:	Principles of Electrical Engineering
Contact hours/week	:	Lecture: 3, Tutorial :0 , Practical :2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, mid-term examination & Practical and theory examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The concepts DC machines with numerical calculation.
2. The concept of Transformer with numerical calculation.

3. The concept of Synchronous machine & IM with numerical calculation.

Topics Covered

UNIT-I 9

DC Machines:

Construction of DC Machines, Armature winding, EMF and torque equation, Armature Reaction,Commutation, Interpoles and Compensating Windings, Performance Characteristics of D.C. generators, Performance Characteristics of D.C. motors,Starting of D.C. motors ; 3point and 4 point starters, Speed control of D.C. motors: Field Control , armature control and Voltage Control (Ward Lenonard method); Efficiency and Testing of D.C. machines (Hopkinson"s and Swinburn"s Test).

UNIT-II 9

Transformers:

Principle of operation, Construction, Phasor diagram, efficiency and voltage regulation of 1-phase transformer, O.C. and S.C. tests, Sumpner"s test, polarity test. Single phase and three phase auto transformers, volt-amp, relation, efficiency, merits & demerits and applications, three phase to 2 phase, 6 phase or 12 phase connections, and their applications.

UNIT-III 9

Induction Motors:

Constructional features of 3-phase induction motor, Rotating magnetic field, Principle of operation, Phasor diagram, equivalent circuit, torque and power equations, Torque- slip characteristics, no load & blocked rotor tests, efficiency, Starting, Speed Control (with and without EMF injection in rotor circuit.) Constructional features and working of 1-phase induction motor, Double revolving field theory, Equivalent circuit, No load and blocked rotor tests, starting methods.

UNIT-IV 9

Synchoronous Machines:

Constructional features and working of 3-phase Alternator, Armature winding, EMF Equation, Winding coefficients, equivalent circuit and phasor diagram, Armature reaction, O. C. & S. C. tests, Voltage Regulation using Synchronous Impedance Method, MMF Method, Potier"s Triangle Method, Two Reaction Theory, Power flow equations of cylindrical and salient pole machines, operating Characteristics, Starting methods of 3-phase synchronous motor, Effect of varying field current at different loads, V- Curves.

EXPERIMENTS

Note: Minimum eight experiments are to be performed from the following list:

1. To obtain magnetization characteristics of a d.c. shunt generator
2. To obtain load characteristics of a d.c. shunt generator
3. To obtain speed control of dc shunt motor using (a) armature resistance control (b) field control.
4. Determine V-curves and inverted V-curves of a three phase synchronous motor.
5. To obtain equivalent circuit, efficiency and voltage regulation of a single phase transformer using O.C. and S.C. tests.
6. To obtain efficiency and voltage regulation of a single phase transformer by Sumpner"s test

7. To study polarity and ratio test of single phase and 3-phase transformers
8. To perform no load and blocked rotor tests on a three phase squirrel cage induction motor and determine equivalent circuit.
9. To perform no load and blocked rotor tests on a single phase induction motor and determine equivalent circuit.
10. To perform open circuit and short circuit tests on a three phase alternator and determine voltage regulation at full load and at unity, 0.8 lagging and leading power factors by Synchronous Method Determine V-curves and inverted V-curves of a three phase synchronous motor

Text Books:

1. I.J. Nagrath&D.P.Kothari," Electrical Machines", Tata McGraw Hill
2. Husain Ashfaq ," Electrical Machines", DhanpatRai& Sons
3. A.E. Fitggerald, C.KingsleyJr and Umans,"Electric Machinery" 6th Edition McGraw Hill, International Student Edition.
4. B.R. Gupta &VandanaSinghal, "Fundamentals of Electrical Machines, New Age International.
5. Irving L. Kosow, "Electric Machine and Tranformers", Prentice Hall of India.
6. M.G. Say, "The Performance and Design of AC machines", Pit man & Sons.
7. Bhag S. Guru and Huseyin R. Hizirogulu, "Electric Machinery and Transformers" Oxford University Press, 2001.
8. P.S.Bimbhra, "Electrical Machinery", Khanna Publisher
9. P.S. Bimbhra, " Generalized Theory of Electrical Machines", Khanna Publishers

EEE- 232 INTRODUCTION TO MICROPROCESSORS

Course category	:	Audit Course
Pre-requisite Course	:	Principles of Electrical Engineering
Contact hours/week	:	Lecture: 3, Tutorial :0 , Practical :2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, mid-term examination & Practical and theory examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Acquire the introductory knowledge of Digital Computer, microprocessor internal architecture and microprocessor development system.
2. Student gains knowledge on Intel 8085 microprocessor detailed internal architecture along with its assembly language programming.
3. Student gains knowledge on Intel 8086 microprocessor detailed internal architecture, instruction set and interrupts.
4. Student gains knowledge on DMA controller, programmed I/O, interrupt controller and programmable timer/counter interface of Intel's 8-bit and 16-bit microprocessors.
5. With the above knowledge the students will be able to understand advanced microprocessors and microcontroller systems

Topics Covered

UNIT-I 9

Introduction to Digital Computer and Microprocessor:

Digital Computers: General architecture and brief description of elements, instruction execution, instruction format, and instruction set, addressing modes, programming system, higher lever languages.

Buses and CPU Timings: Bus size and signals, machine cycle timing diagram, instruction timing, processor timing.

Microprocessor and Microprocessor Development Systems: Evolution of Microprocessor, Microprocessor architecture and its operations, memory, inputs-outputs (I/Os), data transfer schemes interfacing development system.devices, architecture advancements of microprocessors, typical microprocessor

UNIT-II 9

8-bit Microprocessors:

8085 microprocessor: pin configuration, internal architecture. Timing & Signals: control and status, interrupt: ALU, machine cycles,

Addressing Modes: Register addressing, direct addressing; register indirect addressing, immediate addressing, and implicit addressing.

Instruction format, op-codes, mnemonics, no. of bytes, RTL, variants, no. of machine cycles and T states, addressing modes.

Instruction Classification: Data transfer, arithmetic operations, logical operations, branching operation, machine control; Writing assembly Language programs, Assembler directives.

UNIT-III 9

16-bit Microprocessors:

Architecture: Architecture of INTEL 8086 (Bus Interface Unit, Execution unit), register organization, memory addressing, memory segmentation, Operating Modes.

Instruction Set of 8086

Addressing Modes**:** Instruction format: Discussion on instruction Set: Groups: data transfer, arithmetic , logic string, branch control transfer, processor control.

Interrupts: Hardware and software interrupts, responses and types.

UNIT-IV 9

Peripheral Interfacing:

I/O programming: Programmed I/O, Interrupt Driven I/O, DMA I/O interface: serial and parallel communication, memory I/O mapped I/Os. Peripheral Devices: 8237 DMA controller, 8255- Programmable peripheral interface, 8253/8254 Programmable timer/counter. 8259 programmable Interrupt Controller.

Peripheral Interfacing:

I/O programming: Programmed I/O, Interrupt Driven I/O, DMA I/O interface: serial and parallel communication, memory I/O mapped I/Os. Peripheral Devices: 8237 DMA controller, 8255- Programmable peripheral interface, 8253/8254 Programmable timer/counter. 8259 programmable Interrupt Controller.

1. **Text & Reference Books**
2. Gaonkar, Ramesh S, “Microprocessor Architecture, programming and applications with the 8085” Pen ram International Publishing 5th Ed.
3. Uffenbeck, John, “Microcomputers and Microprocessors” PHI/ 3rd Edition.

4. Ray, A.K. &Burchandi, K.M., "Advanced Microprocessors and Peripherals: Architecture, Programaming and Interfacing" Tata Mc. Graw Hill.
5. Krishna Kant, "Microprocessors and Microcontrollers" PHI Learning.
6. Brey, Barry B. "INTEL Microprocessors" Prentice Hall (India)
7. Aditya P. Mathur, "Introduction to Microprocessor" Tata McGraw Hill
8. M. Rafiquzzaman, "Microprocessors- Theory and applications" PHI
9. B. Ram, "Advanced Microprocessor & Interfacing" Tata McGraw Hill
10. Renu Singh &B.P.Singh, "Microprocessor and Interfacing and applications" New Age International
11. Hall D.V., "Microprocessors Interfacing" Tata McGraw Hill
12. Liu and Gibson G.A., "Microcomputer Systems: The 8086/8088 Family" Prentice Hall (India)

MICROPROCESSORS LAB

List of Experiments:

1. To become familiar with 8085 microprocessor training kit and execute following programs on microprocessor kit.
   - Add two 8 bit numbers stored in register B & C store result in register D.
   - Subtract 8 bit data stored at memory location 4021h from data stored at memory location 4020h. Store result at memory location 4022h.
   - To perform OR operation between accumulator and register B. Store result in register C.
2. To become familiar with 8085 microprocessor simulator and simulate following programs using simulator
   - Write a program to interchange content of register B and C
   - Subtract content of register E from register B.
   - Complement content of accumulator and display result on output port PORT2.
   - Perform logical OR operation between register B and C, logical AND operation between accumulator and register B.
3. Write a program to transfer set of data from memory location 2050-205Fh to 2060-206Fh
4. Write a program to find smallest number from given set of data stored at location 2040h to 205Fh
5. Write a program to find negative numbers in given set of data stored at the location 2050h to 205Fh
6. Write program to arrange an array of data in ascending order
7. Write a program to multiply two 8 bit numbers stored at the location 2100 and 2101. Store result at memory location 2102h
8. Write program to divide 16 bit number stored at memory location 2100h and 2101h by 8 bit number stored at memory location 2102h. Store quotient in memory locations 2110h and 2111h, remainder at memory location 2112h.
9. Write a program to separate out (unpack) two digit BCD number and pack (combine) two digit BCD number into one.
10. Write a program to convert hexadecimal number into equivalent BCD number
11. Write a program to check parity of data stored at memory location 2100. Move content EEh to register B, if parity is even and 00h if parity is Odd.
12. Write and execute program to display count value 0 to 9 onthe seven segment display using standard subroutine for display output.
13. Write program to use vector interrupt (VI) RST 7.5 to switch from up counter to down counter.

14. Write program to flash message “EC LAB” on address and data field of display.
15. To interface Programmable peripheral interface (PPI) IC-8255 with 8085 Microprocessor in Mode 0.
16. To generate square wave on port pin PC7 of 8255 in BSR mode.

SWE- 241 INFORMATION TECHNOLOGY FOR LAND AND WATER MANAGEMENT

Theory

Concept of Information Technology (IT) and its application potential. Role of IT in natural resources management. Existing system of information generation and organizations involved in the field of land and water management. Application and production of multimedia. Internet application tools and web technology. Networking system of information. Problems and prospects of new information and communication technology. Development of database concept for effective natural resources management. Application of remote sensing, geographic information system (GIS) and GPS. Rational data base management system. Object oriented approaches. Information system, decision support systems and expert systems. Agricultural information management systems - use of mathematical models and programmes. Application of decision support systems, multi sensor data loggers and overview of software packages in natural resource management. Video-conferencing of scientific information.

Practical

Multimedia production. Internet applications: E-mail, voice mail, web tools and technologies. Handling and maintenance of new information technologies and exploiting their potentials. Exercises on database management using database and spreadsheet programmes. Usage of remote sensing, GIS and GPS survey in information generation and processing. Exercises on running computer software packages dealing with water balance, crop production, land development, land and water allocation, watershed analysis etc. Exercises on simple decision support and expert systems for management of natural resources. Multimedia production using different softwares. Exercises on development of information system on selected theme(s). Video-conferencing of scientific information.

Suggested Readings

1. Climate-Smart Agriculture – Source Book. 2013. Food and Agriculture Organization, Rome. Daniel P. Loucks and Eelco van Beek. 2005. Water Resources Systems Planning and Management - An Introduction to Methods, Models and Applications. UNESCO, Paris.
2. Dipak De and Basavaprabhu Jirli (Eds.). 2010. Communication Suppor for Sustainable Development. Ganga Kaveri Publishing House, Varanasi – 221001.
3. FAO. 1998. Land and Water Resources Information Systems. FAO Land and Water Bulletin 7, Rome.
4. Fuling Bian and Yichun Xie (Eds.). 2015. Geo-Informatics in Resource Management and Sustainable Ecosystem. Springer, New York.
5. ICFAI Business School (IBS). 2012. Information Technology and Systems. IBS Centre for Management Research, Hyderabad.
6. Robert Malliva and Thomas Missimer. 2012. Arid Lands Water Evaluation and Management. Environmental Science. Springer, New York.
7. Sarvanan. R. 2011. Information and Communication Technology for Agriculture and Rural Development. New India Publishing Agency, New Delhi.
8. Soam, S.K., P.D. Sreekanth and N.H. Rao (Eds.). 2013. Geospatial Technologies for Natural Resources Management. New India Publishing Agency, Delhi.

FPE-241 WASTE AND BY-PRODUCTS UTILIZATION

Theory

Types and formation of by-products and waste; Magnitude of waste generation in different food processing industries; Uses of different agricultural by-products from rice mill, sugarcane industry, oil mill etc., Concept, scope and maintenance of waste management and effluent treatment, Temperature, pH, Oxygen demands (BOD, COD), fat, oil and grease content, metal content, forms of phosphorous and sulphur in waste waters, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, Waste utilization in various industries, furnaces and boilers run on agricultural wastes and byproducts, briquetting of biomass as fuel, production of charcoal briquette, generation of electricity using surplus biomass, producer gas generation and utilization, Waste treatment and disposal, design, construction, operation and management of institutional community and family size biogas plants, concept of vermin-composting, Pre-treatment of waste: sedimentation, coagulation, flocculation and floatation, Secondary treatments: Biological and chemical oxygen demand for different food plant waste– trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, lagoons, Tertiary treatments: Advanced waste water treatment process-sand, coal and activated carbon filters , phosphorous, sulphur, nitrogen and heavy metals removal, Assessment, treatment and disposal of solid waste; and biogas generation, Effluent treatment plants, Environmental performance of food industry to comply with ISO-14001 standards.

Practical

Determination of temperature, pH, turbidity solids content, BOD and COD of waste water, Determination of ash content of agricultural wastes and determination of un-burnt carbon in ash, Study about briquetting of agricultural residues, Estimation of excess air for better combustion of briquettes, Study of extraction of oil from rice bran, Study on bioconversion of agricultural wastes, Recovery of germ and germ oil from by-products of cereals, Visit to various industries using waste and food by-products.

Suggested Readings

1. Markel, I.A. 1981. Managing Livestock Waste, AVI Publishing Co.
2. Pantastico, ECB. 1975. Post Harvest Physiology, Handling and utilization of Tropical and Sub-tropical fruits and vegetables, AVI Pub. Co.
3. Shewfelt, R.L. and Prussi, S.E. 1992. Post-Harvest Handling – A Systems approach, Academic Press Inc.
4. USDA. 1992. Agricultural Waste Management Field Hand book. USDA, Washington DC. Weichmann J. 1987. Post Harvest Physiology of vegetables, Marcel and Dekker Verlag.
5. V.K. Joshi & S.K. Sharma. Food Processing Waste Management: Treatment & Utilization. New India Publishing Agency.
6. Vasso Oreopoulou and Winfried Russ (Edited). 2007. Utilization of By-products and Treatment of waste in the Food Industry. Springer Science & Business media, LLC 233 New York.
7. Prashar, Anupama and Bansal, Pratibha. 2007-08. Industrial Safety and Environment. S.K. Kataria and sons, New Delhi
8. Garg, S K. 1998. Environmental Engineering (Vol. II) – Sewage Disposal and Air Pollution Engineering. Khanna Publishers, New Delhi
9. Bhatia, S.C.. 2001. Environmental Pollution and Control in Chemical Process Industries. Khanna Publishers, New Delhi.

REE 241 BIO-ENERGY SYSTEMS: DESIGN AND APPLICATIONS

Theory

Fermentation processes and its general requirements, An overview of aerobic and anaerobic fermentation processes and their industrial application. Heat transfer processes in anaerobic digestion systems, land fill gas technology and potential. Biomass Production: Wastelands, classification and their use through energy plantation, selection of species, methods of field preparation and transplanting. Harvesting of biomass and coppicing characteristics. Biomass preparation techniques for harnessing (size reduction, densification and drying). Thermo- chemical degradation. History of small gas producer engine system. Chemistry of gasification. Gas producer – type, operating principle. Gasifier fuels, properties, preparation, conditioning of producer gas. Application, shaft power generation, thermal application and economics. Trans-esterification for biodiesel production. A range of bio-hydrogen production routes. Environmental aspect of bio-energy, assessment of greenhouse gas mitigation potential.

Practical

Study of anaerobic fermentation system for industrial application, Study of gasification for industrial process heat, Study of biodiesel production unit, Study of biomass densification technique (briquetting, pelletization, and cubing), Integral bio energy system for industrial application, Study of bio energy efficiency in industry and commercial buildings, Study and demonstration of energy efficiency in building, Measuring efficiency of different insulation technique, Study of Brayton, Striling and Rankine cycles, Study of modern greenhouse technologies.

Suggested Readings

1. British Bio Gen. 1997, Anaerobic digestion of farm and food processing practices- Good practice guidelines, London, available on www.britishbiogen.co.UK.
2. Butler, S. 2005. Renewable Energy Academy: Training wood energy professionals.
3. Centre for biomass energy. 1998. Straw for energy production; Technology- Environment-Ecology. Available: www.ens.dk.

Year III

CSE-351 NEURAL NETWORK & FUZZY SYSTEM

Course Category	:	Audit Course
Pre-requisite Course	:	NIL
Contact Hours/Week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Basics of ANN and its learning algorithms.
2. Fuzzy principles and relations.
3. Genetic algorithms and its applications.
4. Hybrid systems and usage of MATLAB toolbox

Topics Covered

UNIT-I 9

Neural Networks-1(Introduction &Architecture) Neuron, Nerve Structure and Synapse, Artificial Neuron and its Model, Activation Functions, Neural Network Architecture: Single Layer and Multilayer Feed Forward Networks, Recurrent Networks, Various Learning Techniques; Perception and Convergence Rule, Auto-Associative and Hetro-Associative Memory

UNIT-II 9

Neural Networks-II (Back Propagation Networks) Architecture: Perceptron Model, Solution, Single Layer Artificial Neural Network, Multilayer Perception Model; Back Propagation Learning Methods, Effect of Learning Rule Co-Efficient ;Back Propagation Algorithm, Factors Affecting Back-propagation Training, Applications.

UNIT-III 9

Fuzzy Logic-I (Introduction) Basic Concepts of Fuzzy Logic, Fuzzy Sets and Crisp Sets, Fuzzy Set Theory and Operations, Properties of Fuzzy Sets, Fuzzy and Crisp Relations, Fuzzy to Crisp Conversion, Membership Functions, Interference in Fuzzy Logic, Fuzzy If-Then Rules, Fuzzy Implications and Fuzzy Algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial Applications.

UNIT-IV

Genetic Algorithm (GA) Basic Concepts, Working Principle, Procedures of GA, Flow Chart of GA, Genetic Representations, (Encoding) Initialization and Selection, Genetic Operators, Mutation, Generational Cycle, Applications

Textbooks

1. S. Rajsekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, Prentice Hall of India.
2. N. P. Padhy, Artificial Intelligence and Intelligent Systems, Oxford University Press.
3. Siman Haykin, Neural Netw0rks, Prentice Hall of India
4. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley India.
5. S.N. Sivanandam & S.N. Deepa, Principles of Soft Computing, John Wiley & Sons, 01-Jun-2007

Reference books

1. Hertz J. Krogh, R.G. Palmer, Introduction to the Theory of Neural Computation, Addison-Wesley, California, 1991
2. Freeman J.A. & D.M. Skapura, Neural Networks: Algorithms, Applications and Programming Techniques, Addison Wesley, Reading, Mass, (1992).

CEE-351 ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT

Course category	:	Audit Course
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination and Theory Examination

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the importance of Environmental Impact Assessment (EIA) and key issues involved in EIA.
2. Identify the environmental attributes for EIA study.
3. Identify methodology & prepare EIA report.
4. Identify methods for prediction of impacts.
5. Formulate Environmental Management Plan (EMP).
6. Understand the role of Environmental Audit (EA) and the methodology of EA.

Topics Covered

UNIT-I 9

Environmental Impact Assessment, Historical Background, Global Environment Policy, Need for EIA

UNIT-II 9

Definition, Aims and Methodology of EIA, Role of EIA as a Planning tool

UNIT-III 9

Environmental Impact Assessment, Projects, Recent case histories, Management and Audit Traditional Approach

UNIT-IV 9

Management through legislation, Management through awareness, Environmental Education and Incentives, Environmental Audit- Definition and Role of EA, Methodology of EA, Current Status of EA

Textbooks

1. Environmental Impact Assessment by Canter

Reference books

1. Environmental Impact Assessment-Training Resource Manual, UNEP
2. EIA Notification, MOEF, Govt. of India
3. Environmental Science and Ecological Studies-S.K. Garg, Rajeshwari Garg and Ranjini Garg

CSE-352 DATABASE MANAGEMENT SYSTEMS

Course Category : Audit Course

Pre-requisite Course : NIL

Contact Hours/Week : Lecture : 3, Tutorial : 0 , Practical: 2

Number of Credits : 4

Course Assessment Methods : Continuous assessment through tutorials, attendance, home assignments, mid-term, practical work, record, viva voce & Practical and theory Examination

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. List and define the fundamental concepts of database management system.
2. Manually execute a given (simple) database design a transaction over it.
3. Manually infer the type of a given (simple) database transaction.
4. Implement (simple) algorithms and data structures as database transaction.
5. Design (large) databases that are modular and have reusable components.
6. Explain on a simple problem how to apply concurrency control over concurrent database transactions.

Topics Covered

UNIT-I 9

Introduction: An Overview of Database Management System, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence and Database Language and Interfaces, Data Definitions Language, DML, Overall Database Structure.

Data Modeling using Entity Relationship Model: ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Concepts of Super Key, Candidate Key, Primary Key, Generalization, Aggregation, Reduction of An ER Diagrams to Tables, Extended ER Model, Relationship of Higher Degree.

UNIT-II 9

Relational Data Model and Language: Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra, Relational Calculus, Tuple And Domain Calculus.

Introduction on SQL: Characteristics of SQL, Advantage of SQL. SQL Data Type and Literals. Types of SQL Commands. SQL Operators and their Procedure. Tables, Views and Indexes. Queries and Sub Queries. Aggregate Functions. Insert, Update and Delete Operations, Joins, Unions, Intersection, Minus, Cursors, Triggers, Procedures in SQL/PL SQL

UNIT-III 9

Database Design &Normalization: Functional Dependencies, Normal Forms, First, Second, Third Normal Forms, BCNF, Inclusion Dependence, Loss Less Join Decompositions, Normalization using FD, MVD, and JDS, Alternative Approaches to Database Design.

UNIT-IV 9

Transaction Processing Concept: Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Checkpoints, Deadlock Handling. **Distributed Database:** Distributed Data Storage, Concurrency Control, Directory System.

Concurrency Control Techniques: Concurrency Control, Locking Techniques for Concurrency Control, Time Stamping Protocols for Concurrency Control, Validation Based Protocol, Multiple Granularity, Multi Version Schemes, Recovery with Concurrent Transaction, Case Study of Oracle.

EXPERIMENTS

1. Exercises to be based on Sybase / Oracle / Postgres / VB / Power Builder / DB2 / MS-Access.
2. Applications involving vendor development systems, stores management system, finance management etc.
3. Creation and querying of database tables for following cases. .
    i. Write SQL queries using logical operations (=,<,>,etc)
    ii. Write SQL queries using SQL operators
    iii. Write SQL query using character, number, date and group functions

iv. Write SQL queries for relational algebra
v. Write SQL queries for extracting data from more than one table
vi. Write SQL queries for sub queries, nested queries
vii. Write program by the use of PL/SQL
viii. Concepts for ROLL BACK, COMMIT & CHECK POINTS
ix. Create VIEWS, CURSORS and TRGGERS & write ASSERTIONS.
x. Create FORMS and REPORTS

4. Design of tables by normalization and dependency analysis.
5. Writing application software with host language interface

Textbooks

1. Date C J, An Introduction to Database Systems, Addison Wesley
2. Korth, Silbertz, Sudarshan, Database Concepts, McGraw Hill
3. Elmasri, Navathe, Fundamentals of Database Systems, Addison Wesley
4. O"Neil, Databases, Elsevier Pub.
5. Leon& Leon, Database Management Systems, Vikas Publishing House
6. Bipin C. Desai, An Introduction to Database Systems, Galgotia Publications
7. Majumdar & Bhattacharya, Database Management System, TMH
8. Ramkrishnan, Gehrke, Database Management System, McGraw Hill
9. Kroenke, Database Processing Fundamentals, Design and Implementation, Pearson Education.
10. J. D. Ulman, Principles of Database and Knowledge base System, Computer Science Press.
11. Maheshwari Jain. DBMS: Complete Practical Approach, Firewall Media, New Delhi

Reference books

1. Ramon a. Mato-Toledo, Pauline K. Cushman, Database Management Systems, Schaums " Outline series, TMH, New Delhi Special Indian Edition 2007
2. Ivan Bayross, Mastering Database Technologies, BPB Publications, New Delhi - First Indian Edition 2006, Reprinted 2011

Humanities & Social Science Electives (Mechanical Engineering)

BSH-113 HUMAN VALUES & PROFESSIONAL ETHICS

Course category	:	Humanities & Social Science Electives (HSSE)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 2, Tutorial : 1 , Practical: 0
Number of Credits	:	3
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To create conducive environment for professionals to grow as good and responsible human beings imbibing values and ethics.
2. Understanding the significance of environment.
3. Developing humanitarian outlook.

Topics Covered

UNIT-I 6

Origin, Meaning, and Definition of Value, Types of Values, Individual Value, Family Value, Societal Value, Human Value, Value in Education System, Understanding Happiness and Prosperity, Self Exploration and Natural Acceptance.

UNIT-II 6

Harmony in family, Harmony in Society, Values Leading to Harmony, Creating a world family, Harmony in Nature, Environment and Sustainable Developmental, Legal aspects of Environment, Holistic Perspectives of Values, Existence and Co-existence.

UNIT-III 6

Origin, Meaning and Definition of Ethics, Ethics: The science of the Morality of The Art of Correct Living, Ethics in Human Acts, Ethics and Religion, Ethical Norms and Laws, Ethics in Literature, Ethics in Science and Technology.

UNIT-IV 6

Ethical Approaches:- Theistic Approach, Atheistic Approach, General and Special Ethics, Professional Ethics: Ethics at work place, Ethics as Skill, Values and Ethics, Ethics with Value Education, Managerial and Business & Corporate Ethics, Corporate Social Responsibilities.

Books & References

1. Bangaria ,G.P et.al A foundation course in Human Values and Professional Ethics**,** Excel books.
2. Govindrajan, M Professional Ethics and Human Values, Eastern Economy Edition
3. Naagrazan, R.S. Textbook on Professional Ethics and Human Values**,** New age International.
4. Misra, Anuranjan and Shukla**,** Dr. R.K. Human values and Professional Ethics, Amazon (Paper Back).
5. Fernando, A.C Business Ethics**:** An Indian Perspective, Pearson, India.

BSH-114 INDUSTRIAL PSYCHOLOGY

Course category	:	Humanities & Social Science Electives (HSSE)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 2, Tutorial : 1 , Practical: 0
Number of Credits	:	3
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Use of various facets of psychology, it problems and understanding.
2. To identify, formulate and solve the real life problems with positive attitude.
3. To inculcate the habit of learning and developing the industrial problems from psychological eyes.

Topics Covered

UNIT-I 6

Introduction to Industrial Psychology and its basic concepts

Nature, Importance and scope of Industrial Psychology, Scientific management, Time and motion study and human relations school

UNIT-II 6

Individual in workplace

Motivation and job satisfaction, Stress management, Organizational culture, Leadership and group- dynamic.

UNIT-III 6

Work environment, Recruitment and selection

Engineering Psychology, Fatigue and boredom, Work environment, Accident and safety, Job- analysis, Recruitment and selection, Psychological tests.

UNIT-IV 6

Performance management and training

Performance appraisal, Importance and Methods of Performance appraisal, Training and development- Concepts and Benefits to the organization.

Books & References

1. Miner, J. B. (1992). Industrial/Organizational Psychology. N Y: McGraw Hill
2. Blum & Naylor (1962). Industrial Psychology. Its Theoretical & Social Foundations CBS Publication
3. Aamodt, M. G. (2007). Industrial/Organization Psychology: An Applied Approach (5e) Wadsworth /Thompson: Belmont, C. A.
4. Aswathappa K. (2008). Human Resource Management (Fifth edition) New Delhi: Tata McGraw Hill
5. Archana Despandey (2010). Industrial Psychology, Sun India Publications, New Delhi.

BSH-115 INDUSTRIAL SOCIOLOGY

Course category	:	Humanities & Social Science Electives (HSSE)
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 2, Tutorial : 1 , Practical: 0
Number of Credits	:	3
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, mid-term examination, and Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Use of various facets of sociology, it problems and understanding.
2. To identify, formulate and solve the real life problems with positive attitude.
3. To inculcate the habit of learning and developing the industrial problems from sociological perspectives.

Topics Covered

UNIT-I 6

Introduction to Industrial Sociology

Nature, Scope and importance of Industrial Sociology, Development of Industrial Sociology and other social sciences. Understanding social structure and social processes: Perspectives of Marx, Weber & Durkheim

UNIT-II 6

Rise and development of industry

Early industrialization- Types of productive systems- Evolution of Productive system and Development of Industry, Primitive Stage, Agrarian economy Stage, Handicrafts Stage, Guild System, Feudal or Manorial System, Putting out System, Industrial Revolution, Industrialization- Causes and Consequences.

UNIT-III 6

Contemporary issues in Industrial Sociology Industrial Policy Resolutions

Social change in contemporary India: Modernization and globalization, Secularism and communalism, Nature of development, Processes of social exclusion and inclusion, Changing nature of work and organization **,**Industrial Grievances, Industrial conflicts, Industrial disputes in India, Strike and Lock-out, Promote industrial Peace. Industrial Policy Resolutions.

UNIT-IV 6

Industrial relations machinery in India

Tripartite and Bipartite Machinery, Code of discipline and standing orders and Trade unionism, The National Commission on Labour, Industrial Relations and Technology, Sociological Approach to Industrial relations

Books & References

1. Durae, Pravin. (2013). Dorling. Kindersley (India) P. Ltd. Pearson education in South Asia.
2. Archana Despandey (2010). Industrial Sociology., Sun India Publications, New Delhi.
3. Ramaswamy, E.A. and Ramaswamy, U. (1981), Industry and Labour, OU Press
4. Dhanagare, D.N. , Themes and Perspectives in Indian Sociology, Rawat
5. Chandoke, Neera & Praveen Priyadarshi (2009), Contemporary India: Economy, Society and Politics, Pearson

List of Suggested Open Electives
For Interdisciplinary Courses offered by Other Departments

MECHANICAL ENGINEERING

MOE-481 FUNDAMENTALS OF MECHANICAL ENGINEERING

Course category	:	Open Elective Courses
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, midterm examination, record, viva voce and Final Examination

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

Topic Covered

UNIT-I 9

Thermodynamics

First and second law of thermodynamics, statements of Second Law of Thermodynamics and their equivalence, Third law of thermodynamics, Steam properties, Steam processes at constant pressure, volume, enthalpy and entropy, Classification of steam boilers, Efficiency and performance analysis, Refrigeration, Vapour compression and vapour absorption cycles, Coefficient of performance (COP), Refrigerant properties

Reciprocating Machines

Steam engines, hypothetical and actual indicator diagrams, Carnot cycle, Otto and Diesel cycles, Working of two and four strokes petrol and diesel IC engines.

UNIT-II 9

Measurement & Metrology

Introduction to measurement and measuring instruments, Types of sensors, Types of transducers and their characteristics, Measurement error and uncertainty analysis, Temperature, pressure, velocity, flow, strain, force and torque measurement, Measurement by dial gauges, slip gauges and sine bar

Engineering Materials

Classification, Ferrous and non ferrous metals, Composition of cast iron and carbon steel, mechanical properties, alloy steel and mechanical properties, Non-ferrous metals such as Cu, Al, Zn, Cr, Ni etc. and its applications.

UNIT-III **9**

Simple Stress and Strain

Introduction, Normal and shear stresses, Poisson‘s ratio, Elastic constants and their relationships, Generalized Hooke‘s law, Deflection of bars of uniform and varying cross-sections, Strain energy in members due to static loading, Statically determinate problems, Stress-strain diagrams for ductile and brittle materials

Mechanical Properties and Testing

Toughness, Hardness, Fracture, Fatigue and Creep, Strength and deformation testing, Bend/rebend testing, Hardness testing, Impact testing, Fatigue testing and creep testing, spring stiffness testing

UNIT-IV **9**

Beams

Introduction, Types of supports, Beams classification, Free body diagram, Shear force and bending moment, Analysis of beams, Continuous loading and discontinuous loading, Shear force and bending moment diagrams for statically determinate beams. Pure Bending of beams. Introduction, Assumptions, Simple bending Final, Stress of beams of different cross sections. Torsion of Circular shafts. Introduction, Torsion of circular shafts, Shear stress due to torsion, Polar modulus, Power transmission

Books & References

1. Basic and Applied Thermodynamics-P. K. Nag (Tata McGraw Hill)
2. Applied Thermodynamics-Onkar Singh (New Age International)

3. Elements of Materials science and Engineering-Van Vlash (Jhon Wiley & Sons)
4. Material Science-V. Raghvan (Prentice Hall India Limited)
5. Mechanical Measurement-G. Beckwith Thomas (Narosa Publishing House)
6. Mechanical Measurement – Sirohi (New Age Publications)
7. Strength of Materials-S. Ramamurtham (Dhanpat rai Publishing Co.)
8. Strength of Materials-R. K. Rajput (S. Chand)
9. Strength of Materials–R. K. Bansal (Lakshmi Publications)

MOE-482 MANUFACTURING PROCESSES

Course category	:	Open Elective Courses
Pre-requisite Course	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, midterm examination and Final Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The students will be able to understand the basic manufacturing processes and different types of mechanical properties of ferrous, non-ferrous metals and alloys.
2. The basic knowledge of different forming and casting processes and foundry tools used for the manufacturing of different products.
3. The knowledge of different machine tools and machining processes, welding processes and their applications.
4. The knowledge of sheet metal processes and their applications, powder metallurgy process, basic heat treatment processes, nonmetallic materials and features of manufacturing establishment

Topics Covered

UNIT-I 9

Introduction

Introduction and importance of Manufacturing processes, classification and overview of Manufacturing processes.

Mechanical Properties of Materials

Strength, elasticity, plasticity, stiffness, malleability, ductility ,brittleness, malleability, toughness hardness, resilience, hardness, machine ability, formability, weldability, Elementary ideas of fracture fatigue & creep.

Steels and Cast Irons

Carbon steels, their classification based on percentage of carbon as low, mild, medium & high carbon steel, their properties & applications. Wrought iron, Cast iron. Alloy steels: stainless steel, tool steel.

Alloys of Non Ferrous Metals

Common uses of various non-ferrous metals (Copper, Zink, Tin, Magnesium, Lead, Aluminum etc.) & alloys and its composition such as Cu-alloys: Brass, Bronze, Al-alloys

UNIT-II 9

Forming Processes

Hot-working & cold-working, Basic metal forming operations & uses of such as: Forging, Rolling, Wire & Tube drawing and Extrusion, and their uses.

Press-work: Die & Punch assembly, cutting and forming, its applications.

Casting

Pattern making, Materials, pattern making tools, pattern types and allowances. Type and composition of Molding sands and their desirable properties. Foundry tools, Mould making with the use of a core. Gating system. Casting defects & remedies. Cupola Furnace. Brief description of various types of casting processes.

UNIT-III 9

Machining

Lathe-machine: principle, types, main parts, specifications and operations performed on it., Basic description of machines and operations of Shaper-Planer, Drilling, Milling & Grinding.

Welding

Introduction, classification of welding processes. Gas-welding, types of flames and their applications. Electric-Arc welding. Resistance welding. Soldering & Brazing processes and their uses.

UNIT-IV 9

Sheet Metal Work

Tools and equipments used in sheet metal work, metals used for sheets, standard specification for sheets, Types of sheet metal operations: shearing, drawing, bending

Powder Metallurgy

Introduction of powder metallurgy process: powder production, blending, compaction, Sintering

Heat Treatment Processes

Introduction to Heat- treatment of carbon steels: annealing, normalizing, quenching, tempering and case-hardening, Introduction to Galvanizing and Electroplating.

Non-Metallic Materials

Common types & uses of Wood, Cement-concrete, Ceramics, Rubber, Plastics and Composite-materials

Manufacturing Establishment

Plant location. Plant layout–its types. Types of Production. Production versus Productivity

Books & References

1. Workshop Technology Vol-I-B. S. Raghubanshi (Dhanpat Rai and Sons)
2. Workshop Technology Vol-II-B. S. Raghubanshi (Dhanpat Rai and Sons)
3. Production Technology - R.K. Jain (Khanna publication
4. Manufacturing Processes- H. N .Gupta, R. C. Gupta, Arun Mittal (New Age publisher)
5. Manufacturing Science -Ghosh and Mallik (EWP)
6. Manufacturing processes – Santosh Bhatnagar (B S publication)
7. Production Technology – P. C. Sharma (S. Chand)
8. Manufacturing Technology – Machine Tools- P. N. Rao (TMH)
9. Manufacturing Technology – Foundry, Forming and Welding- P. N. Rao (TMH).
10. Manufacturing Engineering & Technology- Kalpakjian (Pearson)

MOE-483 ENGINEERING MATERIAL

Course Category : Open Elective Courses
Pre-requisite Course : NIL
Contact Hours/Week : Lecture : 3, Tutorial : 1 , Practical: 0

Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments and Final Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The importance of numerous materials with their basic concepts including crystallography and imperfections.
2. The understanding about the advanced materials testing by different mechanical testing methods such as strength testing, hardness, fatigue, NDT, etc.
3. Different surface behavior studies of engineering materials including heat treatment processes, TTT diagram and other related processes.
4. Different concepts regarding materials and electrical, magnetic, electronic, etc. properties.

Topics Covered

UNIT-I 9

Introduction

Importance of materials, Brief review of modern & atomic concepts in Physics and Chemistry. Atomic models

Crystalline nature of solids

Crystal system unit cell space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices, Imperfections, Defects & Dislocations in solids

UNIT-II 9

Ferrous & Non-ferrous material

Various types of carbon steels, alloy steels and cast irons, its properties, uses and applications, Heat Treatment: Various types of heat treatment processes such as Annealing, Normalizing, Quenching, Tempering, and various case hardening processes. Time Temperature Transformation (TTT) diagrams. Diffusion: Diffusion of Solids, Fick‘s I and II law.

Non-Ferrous metals and alloys

Non-ferrous metals such as Cu, Al, Zn, Cr, Ni etc. and its applications

UNIT-III 9

Dielectric & Magnetic properties

Dielectric Materials and their applications, Concept of magnetism- Dia, para, ferro magnetic materials, Hysteresis, Soft and hard magnetic materials, Magnetic Storages

Electronic Properties

Energy band, concept of conductor, insulator and semi conductor. Intrinsic and extrinsic semi-conductors, P-n junction and transistors, Basic devices and their applications. Bragg‘s law, Messier effect. Type I & II superconductors. High Temp. super conductors. Brief description of other material such as optical and thermal materials, Composite Materials and its uses, Smart materials & Nano-materials and their potential applications

Books & References

1. Material Science and Engineering – Smith, Hashemi and Prakash (Tata McGraw Hill)
2. Material Science- Narula (Tata McGraw Hill)
3. Material Science for Engineering Students- Fischer (Academic Press)

4. Material Science & Engineering - Van Vlash (John Wiley & Sons)
5. Elements of Material Science & Engineering -W.D. Callister (Wiley India Pvt. Ltd.)
6. Technology of Engineering Materials- Philip and Bolton (Butterworth-Heinamann)
7. Material Science -V. Raghvan (Prentice Hall of India)
8. Elements of Material Science & Engineering- Van Vlack (Pearson)

AGRICULTURAL ENGINEERING

AOE-481 PHOTOVOLTAIC TECHNOLOGY AND SYSTEMS

Course Category	:	Open Elective Courses
Pre-requisite Course	:	NIL
Contact Hours/Week	:	Lecture : 3, Tutorial : 0 , Practical: 2
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, Final Examination

Topic Covered :

Unit I

Solar PV Technology: Advantages, Limitations, Current Status of PV technology, SWOT analysis of PV technology. Types of Solar Cell, Wafer based Silicon Cell, Thin film amorphous silicon cell Thin Cadmium Telluride (CdTe) Cell, Copper Indium Gallium Selenide (CiGS) Cell, Thin film crystalline silicon solar cell.

Unit II

Solar Photo Voltaic Module: Solar cell, solar module, solar array, series & parallel connections of cell, mismatch in cell, fill factor, effect of solar radiation and temperature on power output of module, IV and power curve of module. Balance of Solar PV system:

Unit III

Introduction to batteries: Battery classification, lead acid battery, Nicked Cadmium battery, comparison of batteries, battery parameters,

Unit IV

Charge controller: Types of charge controller function of charge controller, PWM type, MPPT type charge controller, Converters: DC to DC converter and DC to AC type converter.

Unit V

Application of Solar PV system: Solar home lighting system, solar lantern, solar fencing, solar street light, solar water pumping system, Roof top solar photovoltaic power plant and smart grid.

Practical

1. Study of V-I characteristics of solar PV system, smart grid technology and application.
2. Manufacturing technique of solar array.
3. Different DC to DC and DC to AC converter
4. Domestic solar lighting system.
5. Various solar module technologies.
6. Safe measurement of PV modules.
7. Electrical characteristics and Commissioning of complete solar PV system.

Suggested Readings

1. Rai GD. 1998. Non-conventional Sources of Energy. Khanna Pub.
2. Rathore N.S., Kurchania A.K., Panwar N.L. 2006. Renewable Energy: Final & Practice,

Himanshu Publications,.
3. Solanki C.S. 2011. Solar Photovoltaic: Fundamentals, Technologies and Applications, PHI Learning Private Ltd.
4. Meinel & Meinel. Applied Solar Energy.
5. Derrick, Francis and Bokalders, Solar Photo-voltaic Products.

AOE-482 REMOTE SENSING AND GIS APPLICATIONS

Course Category	:	Open Elective Courses
Pre-requisite Course	:	NIL
Contact Hours/Week	:	Lecture : 3, Tutorial : 0 , Practical: 2
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, Final Examination

Unit I

Basic component of remote sensing (RS), advantages and limitations of RS, possible use of RS techniques in assessment and monitoring of land and water resources; electromagnetic spectrum, energy interactions in the atmosphere and with the Earth's surface;

Unit II

Major atmospheric windows; principal applications of different wavelength regions; typical spectral reflectance curve for vegetation, soil and water; spectral signatures; different types of sensors and platforms; contrast ratio and possible causes of low contrast; aerial photography; types of aerial photographs, scale of aerial photographs, planning aerial photography- end lap and side lap;

Unit III

Stereoscopic vision, requirements of stereoscopic photographs; air-photo interpretation-interpretation elements; photogrammetry- measurements on a single vertical aerial photograph, measurements on a stereo-pair- vertical measurements by the parallax method; ground control for aerial photography;

Unit IV

Satellite remote sensing, multispectral scanner- whiskbroom and push-broom scanner; different types of resolutions; analysis of digital data- image restoration; image enhancement; information extraction, image classification, unsupervised classification, supervised classification, important consideration in the identification of training areas, vegetation indices; microwave remote sensing. GI Sand basic components,

Unit V

Different sources of spatial data, basic spatial entities, major components of spatial data,

Basic classes of map projections and their properties, Methods of data input into GIS, Data editing, spatial data models and structures, Attribute data management, integrating data (map overlay) in GIS, Application of remote sensing and GIS for the management of land and water resources.

Practical

1. Familiarization with remote sensing and GIS hardware.
2. Use of software for image interpretation.
3. Interpretation of aerial photographs and satellite imagery.
4. Basic GIS operations such as image display.
5. Study of various features of GIS software package.

6. Scanning, digitization of maps and data editing.
7. Data base query and map algebra.
8. GIS supported case studies in water resources management.

Suggested Readings

1. Reddy Anji, M. 2006. Textbook of Remote Sensing and Geographical Information Systems.BS Publications, Hyderabad.
2. Elangovan, K. 2006. GIS Fundamentals Applications and Implementations. New India Publication Agency, New Delhi.
3. George Joseph. 2005. Fundamentals of Remote Sensing. 2nd Edition. Universities Press (India) Private Limited, Hyderabad.
4. Jensen, J.R. 2013. Remote Sensing of the Environment: An Earth Resource Perspective. Pearson Education Limited, UK.
5. Lillesand, T., R.W. Kiefer and J. Chipman. 2015. Remote Sensing and Image Interpretation. 7th Edition, John Wiley and Sons Singapore Pvt. Ltd., Singapore.
6. Sabins, F.F. 2007. Remote Sensing: Principles and Interpretation. Third Edition, Waveland Press Inc., Illinois, USA.
7. Sahu, K.C. 2008. Text Book of Remote Sensing and Geographic Information Systems. Atlantic Publishers and Distributors (P) Ltd., New Delhi.
8. Shultz, G.A. and E.T. Engman. 2000. Remote Sensing in Hydrology and Water Management. Springer, New York

AOE-483 Human Engineering and Safety

Course Category	:	Open Elective Courses
Pre-requisite Course	:	NIL
Contact Hours/Week	:	Lecture : 3, Tutorial : 0 , Practical: 2
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, Final Examination

Topic Covered

Unit I

Human factors in system development – concept of systems; basic processes in system development, performance reliability, human performance.

Unit II

Information input process, visual displays, major types and use of displays, auditory and factual displays. Speech communications.

Unit III

Biomechanics of motion, types of movements, Range of movements, strength and endurance, speed and accuracy, human control of systems.

Unit IV

Human motor activities, controls, tools and related devices. Anthropometry: arrangement and utilization of work space, atmospheric conditions, heat exchange process and performance, air pollution.

Unit V

Dangerous machine (Regulation) act, Rehabilitation and compensation to accident victims, Safety gadgets for spraying, threshing, Chaff cutting and tractor & trailer operation etc.

Practical

1. Calibration of the subject in the laboratory using bi-cycle ergo-meter.
2. Study and calibration of the subject in the laboratory using mechanical treadmill.

3. Use of respiration gas meter from human energy point of view.
4. Use of Heart Rate Monitor.
5. Study of general fatigue of the subject using Blink ratio method.
6. Familiarization with electro-myograph equipment.
7. Anthropometric measurements of selected subjects.
8. Optimum work space layout and locations of controls for different tractors.
9. Familiarization with the noise and vibration equipment.
10. Familiarization with safety gadgets for various farm machines

Suggested Readings

1. Chapanis A. 1996. Human Factors in System Engineering. John Wiley & Sons, New York. Dul J. and Weerdmeester B.1993. Ergonomics for Beginners. A Quick Reference Guide. Taylor and Francis, London.
2. Mathews J. and Knight A. A. 1971. Ergonomics in Agricultural Equipment Design. National Institute of Agricultural Engineering.
3. Astrand P. And and Rodahl K. 1977. Textbook of Work Physiology. Mc Hill Corporation, New York.
4. Mark S. Sanders and Ernest James McCormick. 1993. Human Factors in Engineering and Design.
5. Mc Hill Corporation, New YorkKeegan J J, Radke AO. 1964. Designing vehicle seats for greater comfort. SAE Journal;72:50~5.
6. Yadav R, Tewari V.K. 1998. Tractor operator workplace design-a review. Journal of Terra mechanics 35: 41-53.

COMPUTER SCIENCE & ENGINEERING

COE-481 DATABASE MANAGEMENT SYSTEM, DATA MINING & WAREHOUSING

Course Category	:	Open Elective Coures
Pre-requisite Course	:	NIL
Contact Hours/Week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, midterm examination and Final Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To educate students with fundamental concepts of Database Management System, Data Models, Different Data Base Languages.
2. To analyze Database design methodology.
3. To understand the basic principles, concepts and applications of data warehousing and data mining
4. To introduce the task of data mining as an important phase of knowledge recovery process
5. Ability to do Conceptual, Logical, and Physical design of Data Warehouses OLAP applications and OLAP deployment
6. Have a good knowledge of the fundamental concepts that provide the foundation of data mining

Topics Covered

UNIT-I **9**

Introduction: An Overview of Database Management System, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence and Database Language and Interfaces, Data Definitions Language, DML, Overall Database Structure.

Data Modeling using Entity Relationship Model: ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Concepts of Super Key, Candidate Key, Primary Key, Generalization, Aggregation, Reduction of an ER Diagrams to Tables, Extended ER Model, Relationship of Higher Degree.

UNIT-II **9**

Relational Data Model and Language: Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra, Relational Calculus, Tuple and Domain Calculus.

Introduction on SQL: Characteristics of SQL, Advantage of SQL. SQL Data Type and Literals. Types of SQL Commands. SQL Operators and their Procedure. Tables, Views and Indexes. Queries and Sub Queries. Aggregate Functions. Insert, Update and Delete Operations, Joins, Unions, Intersection, Minus, Cursors, Triggers, Procedures in SQL/PL SQL

UNIT-III **9**

Transaction Processing Concept: Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Checkpoints, Deadlock Handling.

Distributed Database: Distributed Data Storage, Concurrency Control, Directory System.

Concurrency Control Techniques: Concurrency Control, Locking Techniques for Concurrency Control, Time Stamping Protocols for Concurrency Control, Validation Based Protocol, Multiple Granularity, Multi Version Schemes, Recovery with Concurrent Transaction, Case Study of Oracle.

UNIT-IV **9**

Data Mining & Warehousing: Introduction to Data Warehouse, Building A Data Warehouse, Data Warehouse Architecture, OLAP Technology, Introduction to Data Mining, Data Pre-Processing, Mining Association Rules, Classification and Prediction, Cluster Analysis, Advanced Techniques of Data Mining and its Applications.

Textbooks

1. Korth, Silbertz, Sudarshan, Database Concepts, McGraw Hill
2. Jiawei Han, Micheline Kamber, Data Mining Concepts & Techniques, Elsevier
3. Elmasri, Navathe, Fundamentals of Database Systems, Addison Wesley

Reference books

1. Date C J, An Introduction to Database Systems, Addison Wesley
2. J. D. Ulman, Principles of Database and Knowledge base System, Computer Science Press.
3. M. H. Dunham, Data Mining: Introductory and Advanced Topics. Pearson Education
4. Mallach, Data Warehousing System, McGraw –Hill

COE-482 OBJECT ORIENTED TECHNIQUES & JAVA PROGRAMMING

Course Category	:	Program Elective Courses
Pre-requisite Course	:	NIL
Contact Hours/Week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments and Final Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Knowledge of how to develop and deploy applications and applets in JAVA.
2. Knowledge of how to develop and deploy GUI using JAVA Swing and AWT.
3. Design, develop and implement interactive web applications.
4. Be able to implement, compile, test and run JAVA programs comprising more than one class and to address a particular software problem.
5. Develop programs using the JAVA Collection API as well as the JAVA standard class library.

Topics Covered

UNIT-I 9

Introduction: Introduction to Programming Languages, The Evolution of JAVA, Object-Oriented Programming Concepts and JAVA, Differences between C++ and JAVA, Primary Characteristics of JAVA, The Architecture, Programming with JAVA, Operator, Data type, Variable, Arrays, Control Statements, Methods.

UNIT-II 9

Core JAVA: Classes, Inheritance, Package and Interface, Exception Handling, Multithread Programming, I/O, JAVA Applet, String Handling, Networking, Event Handling, Introduction to AWT, AWT Controls, Layout Managers.

UNIT-III 9

JAVA Swing: Creating a Swing Applet and Application, Programming using Panes, Pluggable Look and Feel, Labels, Text Fields, Buttons, Tabbed Panes.

UNIT-IV 9

JDBC: Connectivity Model, JDBC/ODBC Bridge, JAVA.SQL Package, Connectivity to Remote Database,

JAVA Beans: Application Builder Tools, The Bean Developer Kit(BDK), JAR files, Introspection, Developing a Simple Bean, **Servlet:** Introduction to JAVA Servlet: Servlet Basics, Servlet API Basic, Life Cycle of a Servlet, Running Servlet.

Textbooks

1. Naughton, Schildt, The Complete Reference JAVA2, TMH Publication
2. Balaguruswamy E, Programming in JAVA, TMH Publication

Reference books

1. Margaret Levine Young, The Complete Reference Internet, TMH Publication
2. Dustin R. Callway, Inside Servlets, Addison Wesley.
3. Mark Wutica, JAVA Enterprise Edition, QUE. teven Holzner, JAVA2 Black book, Dreamtech

COE-483 INTRODUCTION TO WEB TECHNOLOGY

Course Category	:	Open Elective Courses
Pre-requisite Course	:	NIL
Contact Hours/Week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, Final Examination

Topics Covered

UNIT- I 8

Introduction: Introduction and Web Development Strategies, History of Web and Internet, Protocols governing Web, Writing Web Projects, Connecting to Internet, Introduction to Internet services and tools, Introduction to client-server computing. Core Java: Introduction, Operator, Data type, Variable, Arrays, Methods & Classes, Inheritance, Package and Interface, Exception Handling, Multithread programming, I/O, Java Applet, String handling, Event handling, Introduction to AWT, AWT controls, Layout managers.

UNIT-II 8

Web Page Designing: HTML: list, table, images, frames, forms, CSS, Document type definition, XML: DTD, XML schemes, Object Models, presenting and using XML, Using XML Processors: DOM and SAX, Dynamic HTML.

UNIT-III

Scripting: Java script: Introduction, documents, forms, statements, functions, objects; 8
introduction to AJAX, VB Script, Introduction to Java Beans, Advantage, Properties, BDK, Introduction to EJB, Java Beans API.

UNIT-IV 8

Server Site Programming: Introduction to active server pages (ASP), Introduction to Java Server Page (JSP), JSP Application Design, JSP objects, Conditional Processing, Declaring variables and methods, Sharing data between JSP pages, Sharing Session and Application Data, Database Programming using JDBC, development of java beans in JSP, Introduction to Servelets, Lifecycle, JSDK, Servlet API, Servlet Packages, Introduction to COM/DCOM/CORBA.

UNIT-V 8

PHP (Hypertext Preprocessor): Introduction, syntax, variables, strings, operators, if-else, loop, switch, array, function, form, mail, file upload, session, error, exception, filter, PHP-ODBC.

Text books:

1. Burdman, Jessica, "Collaborative Web Development" Addison Wesley
2. Xavier, C, " Web Technology and Design" , New Age International
3. Ivan Bayross," HTML, DHTML, Java Script, Perl & CGI", BPB Publication
4. Bhave, "Programming with Java", Pearson Education

5. Herbert Schieldt, “The Complete Reference:Java”, TMH. Hans Bergsten, “Java Server Pages”, SPD O’Reilly
6. Ullman, “PHP for the Web: Visual QuickStart Guide”, Pearson Education
7. Margaret Levine Young, “The Complete Reference Internet”, TMH
8. Naughton, Schildt, “The Complete Reference JAVA2”, TMH
9. Balagurusamy E, “Programming in JAVA”, TMH

References:

1. Ramesh Bangia, “Internet and Web Design” , New Age International
2. Ivan Bayross,” HTML, DHTML, Java Script, Perl & CGI”, BPB Publication
3. Deitel, “Java for programmers”, Pearson Education
4. Chris Bates, “Web Programing Building Internet Applications”, 2nd Edition, WILEY, Dreamtech
5. Joel Sklar , “Principal of web Design” Vikash and Thomas Learning
6. Horstmann, “CoreJava”, Addison Wesley

ELECTRONICS AND COMMUNICATION ENGINEERING

EOE-481 NON-CONVENTIONAL ENERGY RESOURCES

Course Category	:	Open Elective Courses
Pre-requisite Course	:	NIL
Contact Hours/Week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, Final Examination

UNIT-I

Introduction

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

Solar Cells:

Final of solar cells. solar cell materials, solar cell array, solar cell power plant, limitations.

UNIT-II

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

UNIT-III

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.

Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations.

Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

UNIT-IV

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations.

Wind Energy: Wind power and its sources, site selection, criterion, momentum Final, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems.

UNIT-V

Bio-mass: Availability of bio-mass and its conversion Final.

Ocean Thermal Energy Conversion (OTEC): Availability, Final and working principle, performance and limitations.

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

Text/References Books:

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

EOE-482 INDUSTRIAL ELECTRONICS

Course Category	:	Open Elective Courses
Pre-requisite Course	:	NIL
Contact Hours/Week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, Final Examination

Thyrestor Characteristics, Two-Transistor Model of Thyristor, thyristor Turn-On di/dt Protection, dv/dt Protection, Thyristor Turn-On, Series Operation of Thyristors, Parallel Operation of Thyristors, Snubber Circuits' Reverse Recovery Transients.

Thyristor Commutation Techniques

Natural Commutation, Forced Commutation, Self Commutation, Impules Commutation, resonant pulse commutation, complementary commutation, External Pulse commutation, Load side commutation, line side commutation.

Controlled rectifiers

Introduction, principle of phase controlled converter operation, single-phase semiconverters, single phase full converters, single phase dual converters, single—phase series converters, three phase half wave converters three phase semiconverters, three phase full converters, three phase dual converters.

AC Voltage Controllers

Introduction, principle of on—of control, principle of phase control, single-phase bidirectional controllers A S with resistive loads, single phase controllers with Inductive loads. Three phase half wave controllers, three phase full wave controllers, three phase bi—directional delta connected controllers, single phase transformer tap changers, cycloconverters, single phase cycloconverters, three phase cyclocon converters, reduction of output harmonics.

DC Choppers

Introduction, principle of step-down operation, Step—down choppers with RL Load principle of step-up operation, performance parameters, switch-mode regulators, thyristor, chopper circuits' Impulse- commutated choppers, Effects of source and load inductance, Impulse—commutated three thyristor choppers, Resonant pulse choppers.

Inverters

Introduction, principle of operation, performance parameters, single phase bridge Inverters, three phase inverters, voltage control of three phase inverter, Harmonic Reductions.

Suggested Text Books & References

1. Rasid , "Power Electronics", Prentice Hall
2. Sen, P.C., "Power Electronics", Wiley eastern.
3. Dubey, G.K., "Thermistor Engineering", Prentice Hall

EOE-483	**PRODUCT DEVELOPMENT**	
Course Category	:	Open Elective Courses
Pre-requisite Course	:	NIL
Contact Hours/Week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, Final Examination

UNIT-1

Concept of Product, definition and scope. Design definitions, old and new design methods, design by evolution, examples such as evolution of sewing M/C, bicycle, safety razor etc., need based developments, technology based developments physical relaibility & economic feasibility of design concepts.

UNIT –II

Murphology of design, divergent, transformation and convergent phases of product design, identification of need, Analysis of need. Design criteria; functional, aesthetics, ergonomics, form, shape, size, colour. Mental blocks, Removal blocs, Ideation techniques, Creativity, Check list.

UNIT –III

Transformations, Brainstorming& Synetics, Morephological techniques. Utility Concept, Utility Valaue, Utility Index, Decision making under Multiple Criteria. Economic aspects, Fixed and variable costs, Break-even analysis.

UNIT-IV

Reliability considerations, Bath tub curve, Reliability of systems in series and parallel, Failure rate, MTTF and MTBF, Optimum spares from Reliability considerations. Design of display and controls, Man- machine interface, Compatibility of displays and controls. Ergonomic aspects, Anthroprometric data and its importance in design. Application of Computers in Product development & design.

UNIT-V

Existing techniques, such as work-study, SQC etc. for improving method & quality of product. Innovation versus Invention. Technological Forecasting. Use of Standards for Design.

Text/Reference Books:

1. A.K. Chitab& R.C. Gupta "Product design & Manufacturing" – Prentice Hall (EE)
2. R.P. Crewford, "The Technology of creation Thinking" Prentice Hall.
3. C.D. Cain, "Product Design & Decision" Bussiness Books.
4. C.D. Cain, "Engg. Product Design" Bussiness Books.

BOE-481	**ENTREPRENEURSHIP DEVELOPMENT**	
Course Category	:	Open Elective Courses
Pre-requisite Course	:	NIL
Contact Hours/Week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, Final Examination

UNIT -I

Entrepreneurship- definition. growth of small scale industries in developing countries and their positions vis-a-vis large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries and sub-control types. Government policy for small scale industry; stages in starting a small scale industry.

UNIT -II

Project identification- assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, benefit cost analysis, discounted cash flow, internal rate of return and net present value methods.

UNIT -III

Accountancy- Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, quality control, marketing, industrial relations, sales and purchases, advertisement, wages and incentive, inventory control, preparation of financial reports, accounts and stores studies.

UNIT -IV

Project Planning and control:

The financial functions, cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. Profit planning and programming, planning cash flow, capital expenditure and operations. control of financial flows, control and communication.

UNIT -V

Laws concerning entrepreneur viz, partnership laws, business ownership, sales and income taxes and workman compensation act. Role of various national and state agencies which render assistance to small scale industries.

Text / Reference Books:

1. Forbat, John, "Entrepreneurship" New Age International.
2. Havinal, Veerbhadrappa, "Management and Entrepreneurship" New Age International
3. Joseph, L. Massod, "Essential of Management", Prentice Hall of India.

BOE-482 ENTERPRISE RESOURCE PLANNING

Course Category	:	Open Elective Courses
Pre-requisite Course	:	NIL
Contact Hours/Week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, Final Examination

Unit I

Manufacturing Industry-Management Characteristics and Information Requirements

Industry classification, Product/Market/process Characteristics, Manufacturing planning and control techniques, ERP Concept & Evaluation History: MRP-1, MRP-II, EPR. Information Technology Advancement: Client server technology, RDBMS.

Unit II

Sales, Purchase & Inventory Control, Concepts

Classification/coding of material & finished goods, sales enquire, quotation, order, invoicing, delivery, finished good valuation, purchase requisition, enquiry, supplier quotation, purchase order, Material receipts, Material issues, methods of issue valuation (FIFO/LIFO/Weighted Average Cost/Std. Cost), Returns from operations, Returns of supplier, Stock Adjustments, Physical Stock verification, ABC analysis. Lot and Locations control, Replenishment order control (safety stocks, report point, economic order quantity)

Manufacturing

Product configuration, Bill of material, Master Production Scheduling, Material Requirement planning, capacity Requirement Planning, Loading and Scheduling. An over view of man power planning and customer manufacturing planning.

Unit III

Financial and Cost Accounting

Basic accounting principles, Day book-Cash, Bank, Journal, Purchase and Sales. Ledger-General, Supplier, Customer, Advances, etc. Bank Reconciliation, Trial Balance, Profit & Loss/Income & Expenditure account and Balance Sheet. Fix Ed assets and depreciation. Budgeting-Revenue, Capital Cash, Cost Elements-Direct material, Direct Labour, Direct expenses and overheads. Margin at costing and Break even analysis, Standard Costing, Activity based costing.

Unit IV

Introduction to A Typical ERP Software

Overview of ERP modules and tools of a software like BaaN.

Unit V

Distribution Module

Module architecture-an overview, item data, Purchase ordering/control, Sales ordering/control, Replenishment order control, Electronic Data Interchange.

Manufacturing Module

Module architecture-an overview, Capacity Requirement, Planning, Engineering change control, Engineering data Management, Master Production Scheduling Material requirement Planning, Product Classification/configuration , Production Planning/control, Repetitive Manufacturing.

Finance Module

Module architecture-an overview, Accounts payable, Accounts receivable, General ledger, Cost allocation, Cash management, Activity based costing, fixed assets, Financial budgeting system.

Suggested Text Books and References

1. Joseph Orlicky, " Materials Requirement Planning, The New Way in Production and Inventory Management". McGraw Hill book company, New Delhi, 1975.
2. BaaN Student Manuals, BaaN Education Centre, Hyderabad, 1996.

BOE-483 E-COMMERCE & IT

Course Category	:	Open Elective Courses
Pre-requisite Course	:	NIL
Contact Hours/Week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, Final Examination

Topic Covered

UNIT 1

Introduction

What is E-Commerce, Forces Behind E-Commerce Industry Framework, Brief history of E-Commerce, Inter Organization Commerce Intra Organization Commerce, and Consumer to Business Electron e-Commerce, Architectural Framework.

UNIT- II

Mobile Commerce

Introduction to Mobile Commerce, Mobile Computing Application, Wireless Application Protocols, WAP Technology, Mobile Information Devices.

UNIT-III

Encryption

World Wide Web & Security, Encryption, Transaction security, Secret Key Encryption,
Public Key Encryption, Virtual Private Network (VPM), Implementation Management Issues.

UNIT-IV

Electronic Payments

Overview of Electronics payments, Digital Token Based Electronics payment System, Smart Cards, Credit 1 Debit Card based EPS, Emerging Financial Instruments, Home Banking online Banking.

Reference books:

1. E.Turban, D. King, D. Viehland, J. Lee, "Electronic Commerce 2006: A Managerial Perspective", Pearson education 2006
2. M. Khosrow-pour, Encyclopedia of E-Commerce, E Government, and Mobile Commerce, Idea Group, 2006.
3. Nabeel Al-Qirim, Electronic Commerce in Small to Medium-Sized Enterprises: Frameworks, Issues, and Implications, Idea Group, 2004
4. P. Candace Deans (editor), E-Commerce and MCommerce Technologies, IRM Press, 2005.
5. Darie, C., Balanescu, E., and Bucica, M., Beginning PHP and PostgreSQL E-Commerce: from novice to professional, Apress, 2006.

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