CURRICULUM

FOR

BACHELOR FOR TECHNOLGY IN

"MECHANICAL ENGINEERING"

SRI SAI UNIVERSITY PALAMPUR

(H.P.) INDIA

JULY 2012

CONTENTS

Foreword

Sri Sai University Palampur Himachal Pardesh has been established with a purpose of empowering people. The Vision and Mission of the university are:-

- **Vision**

To provide quality education for developing all round personality of students through curricular, co-curricular and extracurricular activities to meet ever growing manpower requirements of industry and other sectors of economy as per national priorities.

- **Mission**

a. To establish institutions for imparting quality education.
b. To promote creative and innovative research and development.
c. To ensure quality education by periodic review of curricula through industry- institute interaction.
d. To make efforts for updating knowledge of faculty/ staff through quality improvement programmes (Training and retraining)
e. To promote employability through development of requisite competency skills.
f. To work for cause of weaker sections, physically challenged and women welfare through education and enlightenment.
g. To make life healthier, better and modern by inculcating in students Indian values/ heritage.
h. To bring about out a holistic development of society by educating individuals.

At present programmes in Civil Engineering, Electrical Engineering, Mechanical Engineering, Electronics & Communication Engineering and Computer Science Engineering are being run here to develop manpower having global perspective, faith in our Indian values and culture and competencies desired for profession. In order to keep curriculum relevant and up to date, the University created a position of 'Director Curriculum Development' supported by Board of Studies of different discipline. The objective of this is to make teachers and students to become active partners in design of curriculum and instruction.

Director, Curriculum Development has involved Vice Chancellor, Executive Director and senior faculty members of SSU Palampur and Engineering & Technology Colleges at Pathankot and Amritsar in the revision of curriculum . This has created awareness and importance of systematic curriculum design seminar of various programmes and role expected from all the stake holders.

This curriculum has been designed by taking into account incorporating the existing programmes as being run at SSU Palampur and referring to courses of Punjab Technical University, Jalandhar; various IITs; VIT Vellore; Jamia Milia Islamabad New Delhi; PEC University of technology, Chandigarh and innovations undertaken by NITTTR Chandigarh in curriculum design.

Hope this Curriculum will bring desired results.

Dr Naresh Nagpal
Executive Director
Sri Sai Group of Institutes
Corporate office, Chandigarh.

PREFACE

Curriculum is a plan comprising of learning experiences; to be given to students for developing competencies as desired by the 'world of work' in their professional life. Curriculum for SSU programmes has been designed with active involvement of the faculty and other stake holders. This process of designing the curriculum was a unique learning experience for all those involved in the process and understands the meaning and importance of scientific and systematic design of curriculum. A group of teachers provided feedback to the coordinator to up to date Curriculum. This group also scanned employment opportunities and job skills expected from an engineering graduate for inclusion in the curriculum, so as to make it relevant. This resulted in developing in the faculty a sense of ownership due to their involvement in the process.

The steps followed in the design of Curriculum of the degree programme were:

I. Discussions of Director, Curriculum Development with Chancellor, Vice Chancellor and Executive Director regarding their views on their Vision and Mission of the University vis a vis constraints of programme as well as expectations of Director, Curriculum Development.

II. Orientation programme for senior faculty of SSU to educate them about a rational approach to Curriculum design and to know about their experience of implementing the existing curriculum.

III. Interaction with the faculty from various Institutions to know their view point on their specific discipline, areas of employment, profile of an engineer and curriculum etc.

IV. Analyze the guidelines given by AICTE. ABET and NBA for programme accreditation so as to adhere to the norms and standards for Curriculum of Engineering Degree programmes.

V. Analysis of syllabus and test questions of engineering services examination to ensure that designed curriculum include most of the broad areas and their levels of expectations from fresh graduates.

VI. SSU faculty prepared Horizontal and Vertical organization of subjects of curriculum and learnt about taking decision on various components of Curriculum and their articulation and importance in terms of time. They also understood the logical and chronological placement of subjects in the whole Curriculum.

VII. A workshop was organized at SSCET Pathankot for having understanding of the common features of the programmes; present syllabus being followed at SSU, difference between PTU Curriculum and SSU curriculum and innovation possible in implementation of curriculum.

VIII. Feedback was collected from coordinators of SSU programmes on the aspects given in VII so as to incorporate these in Curriculum document.

IX. Obtain opinion of experts from industry and academic on the proposed curriculum for degree programme in different discipline of Engineering.

X. The curriculum documents were subsequently validated and finalized in consultation with SSU Faculty.

Curriculum provides requisite experiences to students through formal, nonformal and informal activities towards development of occupational, personal, social and continuing learning skills for making students employable. Focus of teachers and students is all the time to active the objective and outcome of the programme stated in the document. Students are made responsible for their learning and teachers become facilitators in this process.

During the design of the curriculum, the constraints of resources of the system in which this curriculum has to be implemented have been considered. It is hoped that with the support of enlightened administration and motivated faculty, innovative methodology will be adopted in teaching-learning process for providing desired learning experiences to the students as stated in curriculum documents.

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1. SALIENT FEATURES OF THE PROGRAMME

1. Name of the programme	:	B. Tech in Mechanical Engineering
2 Duration of the programme:	:	4years
3 Entry Qualification	:	12+ Physics, Chemistry and Mathematics
4 Pattern of Programme	:	Semester system (8 Semesters)
5 Duration of the Semester	:	16 weeks
6 Total hours per week:	:	32 to 36 hours
7 Ecological and Environmental Awareness Camp and follow up	:	Second Semester (2-3) days
8 Entrepreneurship Development Camp and follow up	:	Fifth Semester (2-3)days
9. Industrial Training		*Workshop Practice of 4 weeks during summer vacation after second semester. It will also include Industrial exposure/tour also. • Industrial Training of Six weeks duration in summer vacation after fourth semester • Industrial Training of six months during seventh / eighth semester.
10. Student centered activity S.C.A will include	:	*library study/ independent study for searching and organization Information for use. • Library study • Market survey • Information search (industry/ in trust) • Seminar • Expert lectures • Camp for ecology & Environmental awareness, entrepreneurship development and personality development.

2. JOB OPPORTUNITIES

Mechanical engineering department aims at developing mechanical engineers for industry and service sector. These students are engaged in manufacturing (production) sector; Design sector, thermal sector comprising of power plant, refrigeration and air-conditioning, automobile and rotor dynamics etc; and clean environment and conservation of material and energy sources sector.Mechanical engineers also works in public sector organizations as well as in defense services.A large number of opportunitiesof teachers are also available in technical education and training institutes.

3. PROGRAM OBJECTIVES AND OUTCOMES FOR B.TECH COURSE IN MECHANICAL ENGINEERING

The following are envisaged as sample educational objectives and outcomes of a mechanical engineering programme:

1. To prepare students for successful careers in industry that meet the needs of Indian and multinational companies.
2. To develop the ability among students to synthesize data and technical concepts for application to product design.
3. To provide opportunity for students to work as part of multidisciplinary projects.
4. To provide students with a sound foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze engineering problems and to prepare them for post graduate studies.
5. To promote in students, the awareness of the lifelong learning process and to introduce them to professional ethics and codes of professional practice.
6. An accredited mechanical engineering program is expected to result in the following learning outcomes:
    a) Graduates will demonstrate basic knowledge in mathematics, sciences and engineering.
    b) Graduates will demonstrate the ability to design and conduct experiments, interpret and analyze data and report results.
    c) Graduates will demonstrate the ability to design a mechanical system or a thermal system or a process that meets desired specifications and requirements.
    d) Graduates will demonstrate the ability to function on engineering and science laboratory teams as well as on multidisciplinary design teams.
    e) Graduates will demonstrate the ability to identify, formulate and solve mechanical engineering problems.
    f) Graduates will demonstrate an understanding of their professional and ethical responsibilities.
    g) Graduates will be able to communicate effectively in both verbal and written forms.
    h) Graduates will have the confidence to apply engineering solutions in global and societal contexts.
    i) Graduates should be capable of self education and clearly understand the value of lifelong learning.
    j) Graduates will be broadly educated and will have an understanding of the impact of engineering on society and demonstrate awareness of contemporary issues.
    k) Graduates will be familiar with modern engineering software tools and equipment to analyze mechanical engineering problems.

4. STUDY AND EVALUATION SCHEME
(FIRST TO EIGHTH SEMESTER)

FIRST SEMESTER

S. No.	Subject_Title	STUDY SCHEME			EVALUATION SCHEME		
		Hours/ Week			Marks		
		L	T	P	Internal Marks	External Marks	Total Marks
1.1	Mathematics-I	3	1	--	40	60	100
1.2	Chemistry	3	1	--	40	60	100
1.3	Basic Mechanical Engineering	3	1	--	40	60	100
1.4	Applied Mechanics	3	1	--	40	60	100
1.5	Basic Civil Engineering	3	0	--	40	60	100
1.6	Communication Skill	3	0	--	40	60	100
1.7	Chemistry Laboratory	--	--	2	30	20	50
1.8	Applied Mechanics Laboratory	--	--	2	30	20	50
1.9	Workshop Practice laboratory	--	--	2	30	20	50
1.10	Communication Laboratory	--	--	2	30	20	50
1.11	Student Centered Activities	--	--	2			
	TOTAL	**18**	**4**	**10**	**360**	**440**	**800**

SECOND SEMESTER

S. No.	Subject_Title	STUDY SCHEME			EVALUATION SCHEME		
		Hours/ Week			Marks		
		L	T	P	Internal Marks	External Marks	Total Marks
2.1	Mathematics-II	3	1	--	40	60	100
2.2	Basic Electrical and Electronics Engineering	3	1	--	40	60	100
2.3	Physics	3	1	--	40	60	100
2.4	Computer Programming	3	0	--	40	60	100
2.5	Engineering Graphics	1	0	4	40	60	100
2.6	Principles of Business, Economics and Management	4	0	--	40	60	100
2.7	Basic Electrical & Electronics Engg Laboratory	--	--	2	30	20	50
2.8	Physics Laboratory	--	--	2	30	20	50
2.9	Computer programming Laboratory	--	--	2	30	20	50
2.10	Student Centered Activities	--	--	2			
	TOTAL	**17**	**3**	**12**	**330**	**420**	**750**

THIRD SEMESTER

Sr. No.	Subject_Title	STUDY SCHEME			EVALUATION SCHEME		
		Hours/ Week			Marks		
		L	T	P	Internal Marks	External Marks	Total Marks
3.1	Thermodynamics-1	3	1	--	40	60	100
3.2	Numerical & Statistical Methods	3	1	--	40	60	100
3.3	Machine Drawing	1	0	4	40	60	100
3.4	Fluid Mechanics –I	3	1	--	40	60	100
3.5	Solid Mechanics	3	1	--	40	60	100
3.6	Total Quality Management	3	0	--	40	60	100
3.7	Thermodynamics-1 Laboratory	--	--	2	30	20	50
3.8	Fluid Mechanics-I Laboratory	--	--	2	30	20	50
3.9	Solid Mechanics Laboratory	--	--	2	30	20	50
3.10	Numerical & Statistical Methods Laboratory	--	--	2	30	20	50
3.11	Workshop Training of 4 weeks after 2nd semester	--	--	--	50		50
3.12	Student Centered Activities			2			
	TOTAL	**16**	**4**	**14**	**410**	**440**	**850**

FOURTH SEMESTER

S. No.	Subject_Title	STUDY SCHEME			EVALUATION SCHEME		
		Hours/ Weeks			Marks		
		L	T	P	Internal Marks	External Marks	Total Marks
4.1	Thermodynamics-II	3	1	--	40	60	100
4.2	Environmental studies	3	0	--	40	60	100
4.3	Kinematics of Machines	4	1	--	40	60	100
4.4	Material Science & Metallurgy	4	0	--	40	60	100
4.5	Mechanics of Deformable Bodies	3	1	--	40	60	100
4.6	Industrial Engineering	3	0	--	40	60	100
4.7	Computer Aided Drafting	0	0	4	30	20	50
4.8	Thermodynamics-II Lab	--	--	2	30	20	50
4.9	Student Centered Activities	--	--	2			
	Total	**20**	**3**	**8**	**300**	**400**	**700**

FIFTH SEMESTER

Sr. No	Subject Title	STUDY SCHEME			EVALUATION SCHEME		
		Hours/ Week			Marks		
		L	T	P	Internal Marks	External Marks	TOTAL Marks
5.1	Dynamics of Machines	3	1	--	40	60	100
5.2	Machine Design I	3	1	--	40	60	100
5.3	Manufacturing Processes –I	3	--	--	40	60	100
5.4	Heat and Mass Transfer	3	--	--	40	60	100
5.5	Mechanical Measurements & Metrology	3	1	--	40	60	100
5.6	CAD/CAM	4	0	--	40	60	100
5.7	Machine design Practice I	--	--	2	30	20	50
5.8	Heat and Mass Transfer Lab	--	--	2	30	20	50
5.9	Mechanical Measurement & Metrology Laboratory	--	--	2	30	20	50
5.10	CAD/CAM Laboratory	--	--	2	30	20	50
5.11	Manufacturing Processes –I Lab	--	--	2	30	20	50
5.12	Industrial Training of 6 weeks after 4th semester	--	--	--	40	60	100
	*Student Centered activity	--	--	2			
	Total	**19**	**3**	**12**	**430**	**520**	**950**

SIXTH SEMESTER

Sr. No	Subject Title	STUDY SCHEME			EVALUATION SCHEME		
		Hours/ Week			Marks		
		L	T	P	Internal Marks	External Marks	Total Marks
6.1	Machine Design II	3	1	--	40	60	100
6.2	Refrigeration & Air Conditioning	3	1	--	40	60	100
6.3	Fluid Mechanics-II	3	1	--	40	60	100
6.4	Manufacturing Processes -II	3	1	--	40	60	100
6.5	Mechatronics	3	1	--	40	60	100
6.6	Instrumentation & Control	3	1	--	40	60	100
6.7	Fluid Mechanics-II Lab	--	--	2	30	20	50
6.8	Machine Design Practice (Lab)	--	--	2	30	20	50
6.9	Refrigeration & Air Conditioning Lab	--	--	2	30	20	50
6.10	Mechatronics Lab	--	--	2	30	20	50
6.11	Manufacturing Processes –II Lab	--	--	2	30	20	50
6.12	Student centered activity	--	--	2			
	Total	**18**	**6**	**12**	**390**	**460**	**850**

7th / 8th Semester				
	Subject Title	**Marks**		
		INT	**EXT**	**TOTAl**
	6 months Industrial training	300	200	500
	Software Training(part of 6 months industrial training)	150	100	250
	Total	450	300	750

SEVENTH / EIGHTH SEMESTER

Sr. No	Subject Title	STUDY SCHEME			EVALUATION SCHEME		
		Hours/ Week			Marks		
		L	T	P	Internal Marks	External Marks	TOTAL Marks
8.1	Automobile Engineering	3	1	--	40	60	100
8.2	Elective I	3	--	--	40	60	100
8.3	Elective II	3	--	--	40	60	100
8.4	Operation Research	3	1	--	40	60	100
8.5	Mechanical Vibrations	3	1	--	40	60	100
8.6	Automobile Engineering Lab	--	--	2	30	20	50
8.7	Project	--	--	6	120	80	200
8.8	General Fittness	--	--	--	100		100
8.9	*Student centered activity	--	--	2			
	Total	15	3	10	450	400	850

Elective 1

1. Entrepreneurship Development
2. Maintenance & Reliability Engg
3. Material Management
4. Non conventional Energy System
5. Energy conservation and Management
6. Hydro Power Plant Engg
7. Heat Exchanger Design
8. Industrial Safety and Environment

Elective 2

1. Industrial Automation & robotics
2. Tool Engineering
3. Product Design & Development
4. Power Plant Engineering
5. Hydraulics & Pneumatics

1. DETAILED CONTENT OF VARIOUS SUBJECTS

A. FIRST SEMESTER

1.1 Mathematics-I

MODULE-I

Infinite series: Convergence and divergence of infinite series, geometric series test, comparison tests, p-test, ratio test, root test, Raabe's test, Logarithmic test, Gauss test, Alternating series, power series, radius of convergence, interval of convergence

Differential calculus: Partial derivatives, Homogeneous function, Euler theorem, chain rule, change of variables, Partial differentiation of implicit function, Taylor series of two variables, Maximum and Minimum values of function of two variables, Jacobin, Error and increment .curve tracing.

MODULE-II

Solid Geometry: Sphere, tangent plane, orthogonality, Cone, Cylinder, Quadratic surfaces.

Integral calculus: Rectification, quadrature, volume, Surface area of solid of revolution, double and triple integral, order of integration, change of variables, Application of double and triple integral. beta and gamma function.

MODULE-III

Vector calculus: Differentiation of vector, velocity,acceleration, Scalar and vector field, Gradient of scalar field and directional derivatives, Divergence, Curl of vector field, Physical significance, Integration of vector, Line , surface ,volume integral, Stokes theorem, Divergence theorem, green's theorem

Text Books:

1. *Advanced Engg.Mathematics ,R.K.Jain,S.R.K.Iyengar Narosa Publication, New Delhi*
2. *Higher Engg.Mathematics,B.S.Grewal,Khann Publication*
3. *Higher Engg.Mathematics, N.P.Bali,Laxmi Publication*
4. *Advanced Engg.Mathematics, kreyszig, John Wiley and Sons*

1.2 Chemistry

MODULE I

BASIC CONCEPTS AND WATER TECHNOLOGY: Atomic number, valency, molecular weight, equivalent weight ,morality, normality, how to write a molecular formula.

Water: Structure of water, water as solvent, characteristic properties of water Sources of water, Specifications for water, BOD, COD and DO, Hardness and its determination (EDTA method only), Sewage treatment, Purification of municipal water, Water softening processes – Lime – Soda process, Ion exchange method, boiler feed water, boiler problems-scale, sludge, priming and foaming, caustic mbitterment and boiler corrosion, their causes and prevention, carbonate and phosphate conditioning, colloidal conditioning, calgon treatment, Desalination of water: Reverse osmosis, electro dialysis and multiple effect evaporation. Numerical problems of hardness and Lime-Soda process (7 Hours)

CORROSION SCIENCE: Definition, cause, types and mechanism of corrosion, factors influencing corrosion protective measures against corrosion, metal finishing like electroplating of Au and Cr and electrolessplating of Ni on Al and also preparation of printed circuit board by electrolessplating. (7 Hours)

NON- METALLIC ENGINEERING MATERIALS : (i) Cement : Chemical constitution of Portland cement, functions of different constituents. Theories of the setting of cement. (ii) Abrasives : Introduction, types of abrasives and applications. (7 Hours)

MODULE II

PHOTOCHEMISTRY: Difference between thermo chemical and photochemical rxn., Lambert and beer laws , quantum yield, classification of photochemical rxn, kinetics of some photochemical rxn, Jablonski' s diagram, mechanism of photosensitization, LASER and MASER 7 Hours)

FUELS AND LUBRICANTS : Fuels: Definition, characteristics of good fuel, calorific value: gross and net calorific values and their determination by bomb calorimeter, , Classification of fuels: primary and secondary fuels (7 Hours)

Lubricants: Introduction, friction and wear, Lubricants, mechanism of Lubrications, base oils, additives, greases and emulsions Lubricants :Types of lubrication, fluid film lubrication, boundary lubrication and extreme pressure lubrication. Function of lubricants .Classification of lubricants, solid, semisolid, liquid, emulsions, synthetic lubricants. Conditions for using different types of lubricants. Properties of lubricants.

(7Hours)

MODULE III

Liquid Crystal: Classification of liquid crystals, chemical constitution and liquid crystalline behavior in PAA and MBBA, liquid crystal homologous series, molecular ordering in nematic, smectic and columnar type liquid crystals, identification of liquid crystals using optical microscopy, electro optic properties of liquid crystals, polymorphism in thermotropic liquid crystal and application of liquid crystals(7 Hours)

High Poymers: Definition, classification of polymers, types of polymerization, methods of polymerization, glass transition temp., structure of polymers, plastics, synthesis, properties and applications of few commercial thermoplastic and thermosetting polymers, techniques of plastic moulding, elastomers, adhesive, compounding of resins and plastics, conducting polymers and conduction mechanism in polyacetylene(7 Hours)

Nano-materials: Introduction to nano-materials, Graphite, fullerenes, carbon nanotubes, nanowires, nanocones, Haeckelites. Their electronic and mechanical properties .. Production methods for CNTS. .. Applications of nano materials in i) Medicine ii) Catalysis iii) Environmental Technologies iv) Electronics v) echanics. (5 Hours)

Text Books:-

1. *Shashi Chawla "Engg. Chemistry"*
2. *Vasant Gowarikar "Polymer Chemistry"*
3. *Bandyopadhyay A.K., "Nano Materials" ,New age International Publisher*
4. *Palanna "Engg. Chemistry" TMH*

Reference Books:-

1. *Misra, G.S., Introductory Polymer Chemistry, New Age International (1993).*

1.3 Basic Mechanical Engineering

1. **Thermodynamics**

Heat, work and Internal Energy, Thermodynamic State, Process, Cycle, Thermodynamic System, First Law of Thermodynamics, Application of First Law to steady Flow and Non Flow processes, Limitations of First Law, PMM of first kind (Numerical Treatment), Second Law of Thermodynamics – Statements, Carnot Engine and Carnot Refrigerator, PMM of Second Kind, concept of enthalpy and entropy.

2. **Gas Laws, Gas Processes**

Carnot, Joule, Otto Cycle, Properties at salient points, Air Standard efficiency (Numerical treatment on gas processes and crnot, otto cycles only).

3. **Introduction to IC Engine**

Two stroke, Four Stroke Cycles, Construction and Working of C.I. and S.I. Engines, Air-Fuel ratio, (Descriptive Treatment only)

4. **Introduction to Refrigeration and Air Conditioning**

Vapour compression and vapour absorption system, Psychometric properties of moist air. (Descriptive Treatment only)

5. **Energy Sources**: Renewable and nonrenewable, solar flat plate collector, concentric collector – Parabolic and cylindrical, Photo voltaic cell, Solar energy application solar dryer, Solar pond, solar distillation, Solar refrigeration, Solar cooker, Wind, Geothermal, Wave, Tidal, Hydro power, Bio-gas, Bio-Diesel, Fuel cell, (Descriptive Treatment Only)

6. **Steam Generation**: formation of steam, sensible head, latent heat, Layout of steam power plant (Descriptive Treatment only)

7. **Mechanical Power Transmission** : Type of Belt and belt drives, chain drive, Types of gears and gear Trains, Types of Coupling (Numerical Treatment on velocity ratio of belt drive and gear drive) 8. Pumps, compressor and Hydraulic Turbines : Types, Construction, working and applications

Text Books:-

1. *Nag, P.K., "Engineering Thermodynamics", Tata McGraw – Hill, New Delhi.*
2. *Yadav, R., Thermal Science and Engineering, Central Publishing House, Allahabad.*
3. *G.H.Ryder "Strength of Materials" Macmillan India.*
4. *Mechanics of Materials – Dr. Kirpal Singh, Standard Publishers Distributors, New Delhi.*

Reference Books:-

1. *Popoy , "Strength of Materials", PHI,*
2. *Sadhu Singh, "Strength of Materials" , Khanna Publications.*
3. *Strength of Materials – A Rudimentary Approach – M.A.Jayaram, , Sapna Book House,*

1.4 APPLIED MECHANICS

1. Basic concepts and fundamental laws, force, moment and couple, resolution and composition of force, system of forces, resultant, Varignon's theorem and law of moments.

2. Lami's theorem, free body diagram, two force and three force members, Equilibrium of forces, equilibrium equations, surface friction.

3. Types of loads, types of supports, analysis of simple and compound beams, virtual work method for support reactions.

4. Centroid, moment of inertia of plane and composite figures, parallel and perpendicular axis theorems, moment of inertia of standard shapes from first principle, moment of inertia of composite figures, radius of gyration.

5. Kinematics of rectilinear motion, motion diagrams for under gravity constant acceleration motion, motion with variable acceleration :

6. Kinetics of linear motion, Newton's Law. De Alembert's principle, work-energy principle, Impulse - momentum principle.

7. Kinematics and kinetics of circular motion, rotation with constant and variable angular acceleration, centripetal and centrifugal force, condition of skidding and overturning.

8. Collision of elastic bodies ; direct central impact, oblique impact, coefficient of restitution, loss of kinetic energy

Text Books:

	Author	Title	Publisher
1.	Beer-Johnson	Engineering Mechanics	Tata McGraw Hill, Delhi
2.	Basu	Engineering Mechanics	Tata McGraw Hill, Delhi
3.	Joseph F. Shelley	Vector Mechanics for Enginerrs Vol. I& II	Tata McGraw Hill, Delhi

1.5 BASIC CIVIL ENGINEERING

1. **Introduction to Civil Engineering :** Introduction, branches of civil engineering, application of civil engineering in other allied fields.
2. **Building Planning :** Principles of planning, orientation of buildings, introduction to Bye-Laws regarding building line, height of building, open space requirements, F.S.I., setbacks, ventilation, sanitation as per municipal corporation area requirement.
3. **Components of Buildings :**

• Sub-structure:Types of soil and rocks as foundation strata, concept of bearing capacity, types of foundations i.e. shallow and deep and their suitability. Shallow foundation such as wall foundation, isolated foundation, deep foundation such as pile foundation.

• Super-structure: Elements of super-structures and their functions

4. **Building Design :**

Introduction to types of loads, concepts of strength, stability, durability and factor of safety of building, load bearing and framed structures.

5. **Building Materials :** Use and properties of the following materials :

• Concrete – ingredients and grades, plain and reinforced cement concrete and ready mix concrete, bricks, steel, aluminum, plastic, timber, roofing materials etc.

6. **Surveying :** • Principles of surveying

• Classification of surveys

• Chain Surveying : Introduction to metric chain and tapes, error in chaining, nominal scale and R.F., ranging, chaining and offsetting, index plan, location sketch and recording of field book

• Chain and compass survey

Meridian, bearing and its types, system of bearing,

Types of compass: prismatic and surveyor's compass. Calculation of included angles, correction for local attraction.

7. **Levelling :** • Terms used in levelling, use of Dumpy level, temporary adjustments. Methods of reduction of levels, types of levelling, Contours, characteristics of contours, use of contour maps.

• Introduction to Auto level and use

• Introduction and use of EDM's with special reference to Total Station.

• Measurement of area by planimeter – mechanical and digital.

8. **Transportation Engineering :** • Types of roads : introduction to NH, SH, MDR, ODR, VR, Express Way

• Cross section of road – in cutting and filling

Text Books:

1. Gupta, Sushil Kumar, DR and Juneja BM;"A Text Book of Building Construction";Ludhiana, Katson Publishing House
2. Arora, SP and Bindra, SP; "A Text Book of Building Construction"; New Delhi Dhanpt Rai and Sons,
3. Sushil Kumar; "Building Construction"; Standard Publishers Distribution, Delhi
4. Peurifoy, RL, "Construction Planning, Equipment and Methods" Tokyo, McGraw Hill
5. Wakhlo, ON :Civil Engineering Management", New Delhi Light and Life Publishers

1.6 COMMUNICATION SKILLS

MODULE-I

The Process of Communication: Concept and process of communication; Barriers to Communication; Different Types of Communication; Written vs. Oral Communication; Different Types of Face-to-Face Interactions; Characteristics and Conventions of Conversation; Difference between Conversation and Other Speech Events;

Telephone Techniques: Warm Up; Speaking and Listening: Commonly Used Phrases in Telephone Conversations; Reading: Conference Calls; Vocabulary; Writing and Listening: Leaving a Message; Grammar and Usage- The Perfect Tenses; Pronunciation- Contracted Forms.

Job Applications and Interviews: Curriculum Vitae; Language Focus; Some Useful Words; Preparing for an Interview; Listening and speaking in the interview.

MODULE-II

Group Discussions: How to be Successful in a Group Discussion; Study Skills ; Language Focus; Speaking; Case discussions.

Managing Organisational Structure: The Role of a Manager; Leadership; Language Focus; Writing Reports; Pronunciation.

Meetings: A Successful Meeting; Speaking: One to One Meetings; Language Focus: Opening, Middle and Close; Editing; Criteria for Successful Meetings; Reporting Verbs; Memos

MODULE-III

Taking Notes and Preparing Minutes: Taking Notes- The Essential Components, Preparing Minutes- Format of Minutes, Language and Style of Minutes, Grammer.

Presentation Skills : Presentation Skills; Importance of Body Language in Presentations; pronunciation; Structure of presentation; Visual Aids; Ending the presentation; Podium Panic Pronunciation: Emphasizing the Important Words in Context

Negotiation Skills: Idiomatic Expressions; Process of Negotiations; Phrasal Verbs; Listening: Effective Negotiations; Speaking; Writing.

Technical Report Writing: Objective; Planning; Language; format of the report and guidelines for a good report writing with illustrations of good writing.

Practice Sessions: Students should be asked to prepare and present seminars during the practice session. Group discussions and case discussions should also be used and feedback given to students.

Text Books:-

1. *The Chicago Manual of Style, PHI*
2. *Gowers, Ernest, "The Complete Words". Penguin, 1973.*
3. *IEEE Transactions on "Written and Oral Communications" has many papers of relevance*
4. *Ludlow, R., and Panton, F., "The Essence of Effective Communication", PHI*

1.7 CHEMISTRY LABORATORY

LABORATORY WORK

List of Experiments:-

1. Preparation and standardization of solutions: NaOH, HCl, H_2SO_4 and Oxalic acid
2. To determine the hardness of water sample by EDTA method. (ALL)
3. To determine the acidity of water sample.
4. To determine the amount of residual chlorine in water sample.
5. To determine the total cation conc. In natural water sample using ion exchange resin.
6. To determine COD of a effluent sample.
7. Estimation of rate of corrosion of aluminium in acidic and basic medium.
8. Calorimetric determination of Copper.
9. Verification of Beer's law
10. To determine the surface tension of a liquid using drop no. method.
11. To determine the viscosity of the given liquid by Redwood viscometer.
12. To determine the acid value of the given oil.
13. To determine flash point and fire point of a lubricating oil
14. To determine the mol. Wt. Of polystyrene by viscosity measurements.
15. To determine melting point and/or glass transition temperature of a polymer.
16. To prepare the pure and dry sample of Urea Formaldehyde resin.
17. To prepare the copper ammonia complex
18. Preparation of nano-oxide using combustion method
19. Estimation of moisture and ash content in a given sample of coal.

1.8 APPLIED MECHANICS LABORTOARY

LIST OF PRACTICALS

1. a. Parallelogram law of forces.
   (b) Triangle law of forces
   © Polygon law of forces
2. To verify the forces in different members of a Jib crane.
3. To verify the reaction at the spot of a simply supported beam.
4. To find the Mechanical Advantage, Vel Ratio and efficiency in case of an inclined plane.
5. To find the MA, VR and efficiency of a screw jack.
6. To find the MA, VR, Efficiency of worm wheel.
7. To find MA, VR and efficiency of first & second system of pulleys.
8. To find out the CG of regular lamina.

1.9 WORKSHOP PRACTICES LABORTOARY

LABORATORY WORK

Relevant shop floor exercises involving practice in pattern making, Sand casting, Machining, Welding, Sheet metal fabrication techniques, Fitting work and surface treatment of metals, Demonstration of Forge welding, TIG/MIG/GAS/Spot/Flash butt welding, Demonstration on Shaper, Planer and Milling machine.

1.10 COMMUNICATION LABORATORY

Teacher should give following Assignments to students to develop skills of communicating effectively:

- communation cycle(with the help of Diagram)
- Communication Situation (List of 5 Communication situation stating the type of communication.
- Barriers that hinder a particular communication situation.(state the type of barrier, and how to overcome them)
- Developing a story or a paragraph for the givrn tiopic sentence (in a group of 5-6 students)
- Describing various equipments.
- Identifying the various sentences with their types of writing(e.g. Scientific , legal, colloquial etc.)
- Business letters
- Letters of suggestion
- Comparative Time Table of 2 students
- Description of two different person.
- Letter to the Librarian, Principal
- Report writing.

B. SECOND SEMESTER

2.1 MATHEMATICS-II

MODULE-I

Linear Algebra: Rank, Linear Independent and Dependent, system of liner equations, Eigen values and Eigen vector, Cayley Hamilton theorem, diagonalization, linear transformation, quadratic form and Reduction to canonical form. Complex matrices.

Complex Numbers: De-Movire's theorem and its application, Elementary function of complex variable, Summation of series.

MODULE-II

Function Of Complex Variable: Analytic function, Harmonic functions, Necessary and sufficient condition for the function w= f(z) to be analytic, Application of analytic function in flow problem, complex integrations, Cauchy's integral theorem, Cauchy's integral formula, Cauchy's integral formula for derivatives, Power series, Taylor's and Laurent's series, Zero's & singularities of complex function, Evaluation of real integral using residues, Bilinear transformation and conformal mapping

MODULE-III

Ordinary Differential Equation: Formation of differential equation, Exact differential equation, equation of first order and higher degree equation, Claurit's equation, Linear differential equation , Bernoulli's equation, Linear differential equation with constant coefficient, Method of variation of parameter, Method of undetermined coefficient, Cauchy and Legendre equation , simultaneous differential equation, application of linear differential equation.

Partial Differential Equations And Its Applications: Formation of P.D.E , Lagrange equations, Charpit method, Higher order linear differential equation with constant coefficient.

Text books:-

1. *Simmons, G.F., Differential Equations (With Applications and Historical Notes ,TMH*
2. *Jain,.R.K, .Iyengar "Advanced Engg.Mathematics" , Narosa publication*
3. *Grewal B.S,"Higher Engg.Mathematics",.,Khanna publication*
4. *Kasana, H.S., Complex Variables: Theory and Applications, PHI*

Reference Books:-

1. *Kreyszig Erwin, Advanced Engineering Mathematics, John Wiley (2006*
2. *Ram Babu, Engineering Mathematics, Pearson Education (2009).*
3. *Higher Engg.Mathematics,N.P.Bali,Laxmi Publication*
4. *Advanced Engg.Mathematics,kreyszig,john wiley and sons*

2.2 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Objective/s and Expected outcome:

This course is mandatory for all the branches for understanding the basic concepts of Electrical and Electronics Engineering. Students of all branches have to deal with the applications of Electrical Engineering and Electronics Engineering. This course gives a basic knowledge of circuits, transducers, semiconductor devices with which a building of innovative technology can be created. The students are expected to learn and understand the importance and applications of electric and electronics material. This knowledge give them a brief outline of the fundamentals that would be the foundations of todays‟ and tomorrow‟s technology.

Part A (Electrical Engineering)

1. Direct Current (DC) Circuits:

Circuit elements and connected terminology, Kirchoff‟s Laws- Statement and Illustrations, Method of solving circuits by Kirchoff‟s law, Star-Delta Conversion, Computation of resistance at constant temperature, resistance at different temperatures, Ohm‟s Law- Statement, Illustration and Limitation, Units- Work, Power and Energy (Electrical, Thermal and Mechanical). DC Transients for RL and RC series circuits (7)

2. Alternating Current (AC) Fundamentals:

Generation of alternating electro-motive force EMF, Concept of 3-phase EMF Generation, Peak, Root Mean Square and Average value of alternating current, Phasor representation of alternating quantities, Analysis of AC Circuit Representation of Alternating Quantities in Rectangular and polar forms. Introduction of Resistive, Inductive & Capacitive circuits and their series and parallel combinations. Concept of resonance in series and parallel circuits, Analysis of balanced 03 phase system with star-delta connections. (7)

3. Magnetic Circuits and Transformer:

Comparison between magnetic and electric circuits, Magnetic effects of electric current, Current carrying conductor in magnetic field, Law of Electromagnetic Induction and its law, Self Inductance, Mutual Inductance, Coupling Coefficient between two magnetically coupled circuits. Single Phase Transformer: Construction, Working principle, Efficiency, Voltage regulation and applications.

4. Rotating Electrical Machines:

D.C. machines (motors and generators), Three phase Induction motor,
Synchronous machines (motors and generators): construction, working principle,
classification and applications.

Part B (Electronics Engineering)

5. Transducers:

Introduction, working and application of LVDT, Strain Gauge and Thermistor.
Introduction and application of Digital Multimeter.

6. Semiconductor Devices:

Principle of operation characteristic and application of PN Junction Diode, Rectifiers, Zener Diode, Principle of operation characteristic and application of Bipolar Junction Transistor, Principle of operation and characteristic Field Effect Transistor, Regulated Power Supply.

7. Digital Electronics:

Binary, Octal and Hexadecimal number System & its arithmetic operations, Logic gates, Introduction of R-S, J-K, D and T Flip Flops & its truth tables.

***Reference* Books**

1. Basic Electrical and Electronics and Computer Engineering by RMuthusubramanian, S Salivahanan,K A Muraleedharan, Tata McgrawHill
2. A Textbook of Electrical Techology by B.L Theraja.& A.K Theraja, S Chand publishers.
3. Electrical Technology, Edward Hughes, Addisin Wesley Longman Limited.
4. A Course in electrical and electronic Measurements & Instumentation by A.K Sawhney, Dhanpat Rai & Co.

2.3 PHYSICS

MODULE – I

L**ASER:-**Basic concept of Laser, maser, principle of Laser action Population Conversion pumping its types its types. Types of Laser, Solid, gas and , Semiconductor and its application. Holography & its applications.

Optical Fibers:-Basic Principle of Optical fibre, characteristic of Optical fibre. Numerical aperture, graded Index, Step Index, its relation with Δ, propagation of light in Optical fibre. energy loss during propagations (dispersion), optical communication, through free space, wave guide, its applications.

MODULE – II

Special Theory of relativity: Postulates of specialtheory of relativity, Michelson Morley Experiment, Lerentz Transformation, Length Contraction, Time dilation, addition velocity Relativity of mass Energy equivalence.

Quantum Mechanics: Need of quantum Mechanics**,** De brogile wave phase & group velocity, particle diffraction uncertainty principle, the wave equation, postulates of Quantum mechanics. Time dependent and independent schrodinqer equation, Expectation values, Eigen value, eigen function, particle in a one dimensional box Finite potential well, Harmonic oscillator.

Quantum Statistics: Fermions & Bosons Symmetric & antisymmetric wave functions, Boltzman distribution functions, Base distribution & Fermi distributions function, Comparison of the distributions, Applications of base distribution function specific heat of solid Base-Condensation, Applications of Fermi-distribution functions, Free Electron gas thermionic emission.

MODULE – III

Superconductivity & Magnetism: Basic concept of superconductor, Meissner effect, type I & II superconductors, London equation, BSC Theory, Thermodynamic properties of superconductor Josephson Effect, flux equatization squid, orbital magnetic dipole moments orbital g-factor, magnetic dipole in uniform magnetic field, Electron spin magnetic properties of solid, diamagnetic Theory of para magnetic, susceptibility, Ferro magnetic, Antiferro Magnetic & Ferrimagnetism.

Electro Magnetism: Quantization & conservation of charge, Coulomb's Law, concept of Electric flux, Electric potential conductors, Capacitors, & dielectric materials, magnetic field, Force on a moving charge in a magnetic field, force on current Element, torqueon current Loop, Biot Savart Law, Amphere's Law, Electromagnetic Induction & Faradays Law, Magnetism in materials Maxwell equations, Divergence, gradient & Curl and Significance.

Text Books:-

1. Beiser, A., Concept of Modern Physics, TMH
2. Griffiths, D.J., Introduction to Electrodynamics, PHI
3. Kittel, C., Introduction to Solid State Physics, Wiley,
4. Thyagarajan K & A K Ghatak, Lasers, , Macmillan India Ltd. Banglore.
5. Gerd Keiser Optical Fibre Communication, TMH
6. Arora C.L. Practical Physics, S. Chand & Co.

***Reference Books*:-**

1. Sirohi R.S., Practical Physics, R.S. Sirohi, Wiley Eastern.
2. Modern Phusics, H.C.Ohanian, Prentice Hall.

2.4 COMPUTER PROGRAMMING

Introduction: Elements of computer processing, Hardware and software, Introduction and feature wise comparison of various Operating Systems, Including DOS, Windows and Linux, Problem solving-algorithms and flowcharts.

C Programming Basics: Basic program construction, Structure of a C program, Compilation process. Various compilers available on different OS/ environments including Turbo C, Borland C, gc, gcc, MSVC. Console I/O (printf, scanf), preprocessor directives, Comments, Data types, Type conversions, Operators - arithmetic, Relational, Logical, Conditional, Increment/decrement, Library functions, Header files.

Loops and Decision Statements: *for* loop, *while* loop, *do* loop, Various forms of *if* statement, *switch* statement, *break* statement, *continue* statement, *goto* statement, arrays and strings, Declaring an array, Initializing arrays, Accessing the array elements, Working with multidimensional arrays, Declaring and initializing string variables, Arithmetic operations on characters, String handling functions (string.h), Pointers, Pointers to pointers, Declaring and initializing pointers, Pointer expressions, Pointer increment and scale factor, Pointers and arrays, Pointers and strings.

Functions: Defining functions, Passing arguments to functions, Returning values from functions, Reference arguments, Variables and storage classes, Static functions, Pointers and functions.

Structures and Union: Declaring and initializing a structure, Accessing the members of a structure, Nested structures, Array of structures, Using structures in functions, Pointers and structures, Declaring and initializing a union.

Files: Reading and writing to text and binary files, Character I/O, String I/O, File pointers, Error handling, Redirection, Command line arguments.

Structured Programming vs. Object Oriented Programming.

Text Books

1. *KernighanBrian W. and Ritchie, Dennis M, The C Programming language, Dorling Kingsley(2008) 2nd ed.*
2. *Balagurusamy, E., Programming in Ansi C, TMH.*

Reference Books:-

1. *Stroustrup, Bjarne, The C++ Programming Language,. Addison Wesley*
2. Kanetkar, Yashavant, Let Us C, BPB

2.5 ENGINEERING GRAPHICS

Introduction: Use of drafting tools, Lettering, Dimensions and Standards, Line Conventions.

Projection Systems: Projection Planes, Projection systems, Orthographic projections of points in first angle projection system and third angle projection system, Orthographic projections of lines on reference planes, True length of line using rotation of view method, Traces of lines, Auxiliary planes and their applications, Projections of Lamina parallel/inclined to reference planes, Projection of solids- Polyhedra, Solids of revolution, Sections of solids- Section plane parallel / inclined to reference planes, Intersection of solids.

Development of Surfaces: Development of surfaces like Prism, Pyramid, Cylinder, Cone, Sphere etc. using Parallel Line Method, Radial Line Method, Triangulation method.

Orthographic Projections: Extracting Orthographic projections from given pictorial views.

Isometric Views: Extracting Isometric projections from given Orthographic views using box method, Offset method.

Missing Lines and Missing Views: Evaluating missing lines and missing views from given orthographic views.

Computer Aided Drafting: Introduction to computer drafting tools like AutoCAD. Demonstration of commands like Line, Circle, Arc, Rectangle, MText and Dimensioning etc.

Text Books:-

1. *Gill, P.S., Engineering Drawing - Geometrical Drawings, S.K. Kataria*
2. *Mohan, K.R., Engineering Graphics, Dhanpat Rai Publishing Company*

Reference Books:-

1. *French, Thomas E., Vierck, C. J. and Foster, R. J., Fundamental of Engineering Drawing & Graphics Technology, McGraw Hill Book Company*
2. *Bhatt, N.D. and Panchal, V.M., Engineering Drawing: Plane and Solid Geometry, Charotar Publishing House*

2.6 PRINCIPLES OF ECONOMICS & MANAGEMENT

MODULE-I

Economics: Definitions, Nature & scope of Economics, Economics Systems-meaning of Capitalism, Socialism & mixed economy.

Demand And Supplies Analysis: Law of demand and supply, exception to the law of demand, Elasticity of demand and supply and their types, Methods of measuring elasticity of demand and supply.

Theory of Production: Scales of production, Law of returns, Break even analysis.

Monetary System: Monetary Policy – Meaning, objectives, methods, Fiscal policy – Meaning & objectives of fiscal policy in a developing country like India, Functions of Reserve Bank of India and commercial banks.

MODULE-II

Economics & Business Environment: Privatization –Growth of private capitalism in India, Business/Trade Cycles – Meaning, Characteristics & classification, foreign capital & economic development.

Management Principles: Meaning & types of Management, Concept of Scientific Management, Management by Objectives, System Approach to Management.

Financial Management: Meaning, functional areas of financial management, Sources of Finance, Meaning of financial accounting, accounting principles-concepts & conventions, Importance of final accounts – profit & loss a/c and balance sheet, Need and importance of capital budgeting.

MODULE-III

Marketing Management: Introduction to marketing management, Market segmentation, Developing & managing advertising programs, Deciding on media & measuring effectiveness.

Production Management: Procedure for production planning & Control, Plant Location & Lay-out, Routing, Scheduling, CPM & PERT

Quality Management: Statistical Quality Control, introduction Control Charts, X Charts, R Charts, Control Charts for C (N. of defects per unit), Control chart for P(Fraction defective), Advantages & Limitations of SQC, Quality Circles:- Structure, functions & Limitations.

Text Books:-

1. Dewett , K.K., Modern Economic Theory , S.Chand & Co
2. Singh. P. and Habra, T. N., Business Organization & Management, Dhanpat Rai & Sons
3. Kotler, Philip., Marketing Management, PHI
4. I.M. Pandey., Financial Management, Vikas Publishing House Pvt. Ltd.

***Reference Books*:-**

1. Ruddar Dutt, K.P.M.Sundaram., Indian Economy, S.Chand & Co.
2. Ahuja, H.L, Advanced Economic Theory, S.Chand & Co.
3. Grant, Leaven worth, Statistical Quality Control ,TMH
4. Edwin B.Flippo, Personnel Management , TMH
5. Koontz Harold, Management – A Global Perspective, TMH

2.7 BASIC ELECTRICAL & ELECTRONICS ENGG LABORATORY

LABORATORY WORK

Kirchhoff's laws, Network theorems, A.C. series and parallel circuits, Resonant circuit, Measurement of power 3–phase circuits, Reactance calculation of variable reactance choke coil, Tests on transformers, Starting methods of DC motor, Three phase induction motor and single phase induction motor, Identification and testing of devices (R, L, C, Diode and Transistor), V–I Characteristics of P–N diode, Zener diode , BJT as amplifier, Use of diode as half wave and full wave rectifier.

2.8 PHYSICS LABORATORY

LABORATORY WORK

List of Experiments

1. To find the frequency of A.C. mains using Electric Vibrator.
2. To determine the resistivity & Hall coefficient of a Semi Conductor by four probe method at different temperature.
3. To study the variation of magnetic field of a circular coil Carrying current I & Calculate the radius of coil.
4. To study the divergence of a Laser beam.
5. To determine the wave length of Laser using diffraction grating.
6. Determine the numerical aperture of an optical fibre.
7. To determine attenuation and propagation Lasses in optical fibre.
8. Making up the hologram using advanced Laser hit.
9. To find the susceptibility of ferro magnetic material (Fecl3) by quince Method.
10. To study Laser interference using Michelson Morley Interferometer
11. To study the photovoltaic cell & hence to verify the inverse square law.
12. To convert a galvanometer into an ammeter of a given range.
13. To find the value of plank's constant by using a photo electric cell.
14. To find the Low resistance by Carry Foster's Bridge.
15. To fine the temperature coefficient of resistance by using platinum resistance thermometer by bridge.

2.9 COMPUTER PROGRAMMING LABORATORY

LABORATORY WORK

Introduction to Hardware - CPU, Storage devices & media, VDU, I/O Devices.Basic Operating System (DOS/UNIX) commands. Simple programs to demonstrate the use of constants, Variables, printf, scanf and operators. Programs using Loops: Solution of quadratic equation, Summation of finite series, Fibonacci series, Prime numbers, Factorial. Menu driven programs using switch statement. Use of continue and break statements, Conditional operators. Passing variables to functions by values and by reference, Number conversion using array, Sorting, Merging, Arithmetic operations on matrices. String manipulation: Comparing, Copying, Reversing , Finding length, Extracting characters. Simple programs demonstrating the concept of Pointers, Passing values to functions using pointers for arrays, Structures. Creating various types of records using structures. Storing and retrieving records from a file, Copying a data file. Randomly accessing a record, Use of command line arguments.

C. THIRD SEMESTER

3.1 THERMODYNAMICS-I

1. **Review of laws of Thermodynamics, Entropy:** Clausius inequality, entropy as a property of system, entropy of pure substance. T-s and h-s planes, entropy change in a reversible and irreversible processes, increase of entropy principle, calculation of entropy changes of gases and vapours, Statement of third law of thermodynamics.

2. **Availability**: Available and unavailable energy: availability of a closed and open system, availability of work and heat reservoirs, Anergy, energy and exergy and simple numericals.

3. **Properties of Pure Substances:** Properties of steam, use of steam table and Mollier chart, Deviation of real gases from ideal gases, Equations of state- Vander Waal, Beattie-Bridgemen, Virial & Diterici's equations, P-V-T surfaces & triple point of water.(Descriptive treatment)

5. **Vapour Power Cycles:** Carnot cycle using steam, limitations of Carnot cycle Rankine cycle, representation on T-s and h-s planes, thermal efficiency, Reheat regenerative steam power cycles, specific steam consumption. Work ratio, effect of steam supply pressure and temperature, condenser pressure on the performance. (Numerical Treatment)

6. **BOILERS**: Types, water tubes and fire tube boilers, high pressure boilers, mounting and accessories, natural and forced circulation, Boiler draught, Boiler trail and heat balance.

7. **Steam Condensers :** Functions, elements of condensing plant, types of steam condensers, surface and jet condensers, comparison, vacuum efficiency, condenser efficiency, loss of vacuum, sources of air leakages, methods of leak detection, air extraction methods, estimation of cooling water required, capacity of air extraction pump,air ejectors.

8. **Steam Nozzles**:Functions, shapes, critical pressure ratio, maximum discharge condition, effect of faction, design of throat and exit areas, nozzle efficiency, velocity coefficient, coefficient of discharge, supersaturated flow, degree of under-cooling and degree of super saturation, effects of super saturation.

9. **Steam Turbines :**

- Principles of operation, classification, impulse and reaction steam turbine, compounding of steam turbines.
- Flow through impulse turbine blades, velocity diagrams, work done, efficiencies, end thrust, blade friction, influence of ratio of blade speed to steam speed on efficiency of single and multistage turbines and its condition curve and reheat factors.
- Flow through impulse reaction blades, velocity diagram, and degree of reaction, parson's reaction turbine, and backpressure and pass out turbine.
- Governing of steam turbines. Josses in steam turbines, performance of steam turbines.
- Function of diaphragm, glands, turbine troubles like erosion, corrosion, vibration, fouling etc.

Books

1. Heat Engineering by Dr Vasandani and Dr Kumar; Metropolitan Book Co. Pvt. Ltd., Delhi
2. Thermal Engineering by PL Ballaney; Khanna Publishers, Delhi
3. Engineering Thermodynamics: Work and Hest Transfer By Rogers and Mayhew; ELBS Publications
4. Thermodynamics and Heat Engines Vol. I and II by R Yadav; Central Publishers, Allahabad
5. Steam Turbine Theory and Pratice by WAJ Keartan, ELBS Series
6. Applied Thermodynamics by TD Eastop & A Mc Conkey, ELBS Publications

3.2 NUMERICAL & STATISTICAL METHOD

1. **Errors in Numerical Calculations**
Errors and their analysis, general error formula, errors in a series approximation
2. Solution of algebraic and Transcendental equations: Bisection method, iteration method, Method of false position,, Newton -Raphson method, solution of systems of non linear equations, method of iteration
3. **Interpolation method:**
Errors in polynomial interpretation, finite difference , forward, backward and central difference, Difference of a polynomial, Newtons formulae for interpolation, central difference intepolation formulae, Interpolation with unevenly spaced points, Newton's general interpolation formula, interpolation by iteration
4. **Curve Fitting:**
Cubic splines and approximation:introduction, Least square curve fitting,,Procedures -fitting a straight line, non linear curve fitting, curve fitting by a sum of exponentials, Data fitting with cubic splines-derivation of governing equation, end conditions
5.**Numericl Differentiation and Integration**
Numerical differentiation- cubic spline method: maximum and minimum values of a tabulated function; Numerical Integration- trapezoidal rule, Simpson1/3 rule, Simpsons 3/8 rule, Newton-cots integration formulae; Euler-Meclaurin formula, Gaussian integration(One dimensional only)
6.**Matrices and Linear systems of equations**
Introduction, Inverse of Matrix, Solution of linear systems, Matrix inversion method, Gaussian Elimination method(fall and banded symmetric and unsymmetric systems), Eigen value problems
7. **Numerical solution of ordinary differential equations:**
Solution by Taylor's series, Prediction -correction method, Boundary value problems, Prediction corrector method, Euler's and modified Euler's method, Runge-Kutta method, finite difference methods
8. **Numerical solution of Partial differential equations**
Finite difference approximation to derivatives, Solution to Laplaces equation- Jacobi's method, Gauss -Siedel method, S.O.R method, Parabolic equation and their solution using iterative methods

Reference Books:

1. Computer Oriented Numerical Methods- V. RajaRaman
2. Numerical Methods in Fortran -Mc Cromik and Salavadory
3. Elementary Numerical Analysis, S.D. Conte, & Cari De Boor. Mc Graw Hill.
4. Applied Numerical Methods, Cornahn B., Et al, John Wiley.

3.3 MACHINE DRAWING

Introduction to Mechanical Drawing: Classification of drawings, Principles of drawing, Conventions according to IS, Sectional Views and rules of sectioning, Machining and Surface Finish symbols indicating tolerances in dimensioning, Detailed Drawings.

Manual Drafting and Computer Aided Drafting using s/w like Pro-desktop or Pro-E or AutoCAD, Standards, Types, Practical applications and working of:

(a) Machine Components: Screw fasteners, Keys cotters and joints, Shaft couplings, Pipe joints and fittings, Riveted joints and welded joints.

(b) Assemblies: Bearings (Plumber Block, Footstep, Swivel), Hangers and Brackets, Steam and I.C. Engine Parts, Machine components, Valves.

Case Studies in Computer Plots and Industrial Blueprints.

Laboratory Work:

Manual Drafting (MD) and/or Computer Aided Drafting (CAD) (using s/w like Pro-E or AutoCAD) of: (a) Machine Components: Screw fasteners, Keys cotters and joints, Shaft couplings, Pipe joints and fittings, Riveted joints and welded joints. (b) Assemblies: Bearings (Plumber Block, Footstep, Swivel), Hangers and Brackets, Engine Parts, Machine components, Valves.

Exercise in computer plots of drawings/ blueprints.

Text Books:-

1. *Gill, P.S., Machine Drawing, S.K.Kataria and Sons (2008).*
2. *Bhatt, N.D. and panchal, V.M., , Machine Drawing, Charotar Publishing House (2008).*

Reference Books:-

1. *Pohit, G. and Ghosh, G., Machine Drawing with AutoCAD, Dorling Kindersley (2007).*
2. *French, T.E. and Vierck, C.J., Graphic Science and Design, McGraw Hill (2000).*
3. *Dhawan, R.K., Machine Drawing, S. Chand (2003).*
4. *Narayana, K.L., Kannaiah P. and Venketareddy, K., Machine Drawing, New Age International Publishers (2004).*

3.4 FLUID MECHANICS-I

Fluid statics: Basic equations, pressure and its relationship with height, pressure diagram, hydrostatic forces on submerged bodies, buoyancy and floatation, liquids in relative equilibrium.

Fluid kinematics: Flow characteristics, continuity equation, acceleration of fluid particles, rotational and irrotational motion, circulation and vorticity, velocity potential and stream function, streamlines, equipotential lines, flow net - method, use and limitations.

Fluid dynamics: Euler's equation, energy equation and Bernoulli's equation, application of Bernoulli's equation orifice meter, venture meter, pivot tube etc., flow through orifice, mouth piece, weir and notches, impulse momentum equation and its application, pipe junction, bends, stationary flat and curved vanes, moment of momentum equation.

Flow through pipes: Reynolds' experiment, laws of fluid friction, Darcy Weisbach equation, energy losses, equivalent pipe, pipes in series and parallel, branched pipes, time of emptying a reservoir through pipe, pipe networks.

Laminar flow: Laminar flow through circular pipes, parallel plates, open channel, Porous media, couette flow, Stokes law, measurement of viscosity, transition from laminar to turbulent flow.

Dimensional analysis and similitude: Dimensional homogeneity, Non Diomensional parameter, Π theorem, dimensional analysis chice of variables, Reyleigh methods, examples Rise in capillary tube, head characteristics of a pump, drag on a ship, Fall velocity of a sphere, velocity in an open channel, pipe orifice, discharge over a sharpedge weir, celerity of a gravity wave. Model analysis similitude, types of similarities, force ratios, similarity laws, model classification, scale effects.

Boundary layer theory: Types, boundary layer thickness and equations, momentum integral equation boundary layer on rough surfaces, total drag on flat plate due to laminar and turbulent boundary layer, boundary layer separation and its control.

Turbulent flow: Shear stresses, establishment of flow, types of boundaries, mixing length concept, velocity distribution, mean velocity and resistance to flow in smooth and rough pipes, friction in non circular conduits.

Flow measurement: Measurement of pressure- static, dynamic and total pressure, Piezometric head, Measurement of velocity- Pitot tube and prandtll tube. Measure flow through orifice, mouth piece, weir and notches, measurement of discharge-orifice, mouthpiece weir and notches, orifice meter, Flow nozzle, Venturi flume.

Flow through open channels: Classification of flow, Uniform flow, Prismatic and non prismatic channel, Hydraulically efficient channel cross sections, specific energy, specific energy curves, critical flow in rectangular channels.

Turbines and pumps: Brief description of types and working of turbines and pumps.

Text Books*:-*

1. *Douglas JF, Gasiorek JM, Swaffield JP, Fluid Mechanics; Pitman*
2. *Streetes VL & Wylie EB; Fluid Mechanics : McGraw Hill book company.*
3. *Kumar D.S; "Fluid Mechanics and Fluid Power Engineering" S.K.Kataria*
4. *Garde R.J. and A.G.Mirajgaoker "Engineering Fluid Mechanics", Nem Chand & Bros,*
5. *Garde R.J. "Fluid Mechanics through Problems" Wiley Eastern Ltd,*

Reference Books:-

1. *Subramanya, K., Theory and Application of Fluid Mechanics, Tata McGraw Hill*
2. *Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics, Standard Book House*
3. *Asawa G.L , Experimental "Fluid Mechanics" vol-I,, Nem Chand & Bros*
4. *Bansal R.K, Fluid Mechanics & Hydraulic Machines :*
5. *Massey B. S, "Mechanics of fluid ", Van Nostrand Reinhold Co.*

3.5 SOLID MECHANICS

Axial Stress and Strain: Concept of stress and strain, Generalized Hooke's law, Stress-strain diagram of ductile and brittle materials, properties of engineering materials, Statically determinate and indeterminate problems, Compound and composite bars, Thermal stresses.

Torsion of Circular shafts: Basic assumptions, Torsion formula, Power transmitted by shafts, Design of solid and hollow shafts based on strength and stiffness.

Shear Force and Bending Moment Diagrams: Types of load on beam, Classification of beams, Shear force and bending moment diagrams: Simply supported, Overhung and Cantilever beams subjected to any combination of point loads, Uniformly distributed and varying load and moment, Relationship between load, shear force and bending moment.

Theory of Pure Bending: Derivation of flexural formula for straight beams, bending stress calculation for beams of simple and built up sections, Flitched beams.

Shear Stresses in Beams: Shear stress formula for beams, Shear stress distribution in beams.

Stability of Columns: Crippling load of an axially loaded columns under different end conditions, Euler's and Rankine's formula.

Deflection of Beams: Governing differential equation for deflection of straight beams having constant flexural rigidity, double integration and Macaulay's methods for slopes and deflection, Moment area method, Conjugate beams method.

Analysis of Plane Stress and Strains: Transformation equations for plane stress and plane strain, Mohr's stress circle, Relation between elastic constants, Strain measurements, Strain rosettes.

Theories of Failure: Theories of elastic failure, graphical comparison of theories of failure.

Text Books:-

1. *Popov, E.P. and Balan, T.A., Engineering Mechanics of Solids, PHI*
2. *Singh, D.K., Mechanics of Solids, Pearson Education*

Reference Books:-

1. *Shames, I. H. and Pitarresi, J. M., Solid Mechanics, PHI*
2. *Crandall, S.H., Dahl, N.C. and Lardner., An Introduction to Mechanics of Solids, MH*

3.6 TOTAL QUALITY MANAGEMENT

INTRODUCTION TO QUALITY MANAGEMENT: Definitions – TOM framework, benefits, awareness and obstacles. Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.

PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT: Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle, Japanese 5S principles and 8D methodology.

STATISTICAL PROCESS CONTROL AND PROCESS CAPABILITY: Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed. Process capability – meaning, significance and measurement – Six sigma concepts of process capability. Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve.Total productive maintenance (TMP) – relevance to TQM, Terotechnology. Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.

TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT: Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation. Seven old (statistical) tools. Seven new management tools. Bench marking and POKA YOKE.

QUALITY SYSTEMS ORGANIZING AND IMPLEMENTATION: Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward- Introduction to software quality.

Text Books:-

1. *Dale H.Besterfield et al, Total Quality Management, Third edition, Pearson Education*
2. *Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing*

3.7 THERMODYNAMICS –I LABORATORY

- Study of Nestler Boiler, Lancashire Boiler, Babcock and Wilcox boiler Boiler trial: Estimation of equivalent evaporation and efficiency of a fire tube/ water tube boiler.
- Determination of dryness fraction of steam and estimation of brake power,
- Rankine efficiency, relative efficiency, generator efficiency, and overall efficiency of a steam engine/ steam turbine unit and plotting of William line. Performance of single stage/ multi stage reciprocating compressor

3.8 FLUID MECHANICS LABORATORY

List of Experiments

1. To determine the meta-centric height of a ship model
2. Verification of Bernoulli's theorem
3. To calibrate a venturimeter and to determine its coefficient of discharge
4. To calibrate an orifice meter and study the variation of the coefficient of discharge with the Reynolds number
5. To study the flow over v notch (weir) and to find the coefficient of discharge
6. To determine the hydraulic coefficient of discharge of a mouth piece.
7. To verify the momentum equation experimentally
8. To determine the coefficient of friction of pipes of different diameters.
9. To determine the form losses in a pipe line
10. To obtain the surface profile on the total heads distribution of a forced vortex
11. Viscous flow analogy (Hele-Shaw apparatus) for flow net.
12. Electrical analogy for flow net.
13. Study of flow measurement devices through rotameter apparatus

3.9 SOLID MECHANICS LABORATORY

LABORATORY WORK

Tests for Hardness, Bending, Impact, Tensile strength, Torsion and Compression tests.

List Of Experiments:-

1. Rockwell/Brinell hardness number of given specimens.
2. Vicker's hardness number test.
3. Torsion test (destructive): to determine the torsional rigidity of the material.
4. Tensile test on strip/universal testing machine – to obtain the young's modulus of elasticity, tensile strength and percentage elongation of the material.
5. Impact strength of the given material – Izod's and Charpy tests.
6. Experimentally determine the value of E of the beam material using deflections formula for cantilever and simply supported beams.
7. Non-destructive torsion test to determine modulus of rigidity of the shaft material.
8. To study the behavior of the material on UTM.

3.10 NUMERICAL & SATISTICAL METHOD LABORATORY

1. To develop computer program to determine roots of a given equation using method of:
    a. False position
    b. Newton -Raphson method,
2. To develop computer programs for solution of system of simultaneous linear equations using:
    a. Gauss Elimination Technique, without and with specified boundary conditions, for full as well as bounded symmetric and unsymmetrical matrices
    b. Gauss Shield iterative technique Successive over Relaxation(S.O.R) Technique
3. Linear and Non-Linear curve fitting technique
4. Numerical Integration with Simpson's rule and Gaussian Integration
5. Solution of ordinary differential equations by (i) Eular Method (ii) Runge-Kutta Method (iii) Taylor Series Methods
6. Solution of partial differential equations using S.O.R. Technique with special Reference to heat conclusion equation.

D. FOURTH SEMESTER

4.1 THERMODYNAMICS-II

1. **Introduction to I.C. Engines:** Introduction, Basic engine components and nomenclature, Classification of I. C. Engines, applications.

2. **Engine Cycles:** Engine cycles, Deviation of actual cycles from air standard cycles, Valve timing diagram for high & low speed engine, Port timing diagram.

3. **Fuel systems for S.I. Engines:** Engine fuel requirements, complete carburetor, Derivation for calculation of A/F ratio, Calculation of main dimensions of carburetors, Effect of altitude on Air fuel ratio. Electronic Petrol injection system (MPFI) – components such as sensors, ECU etc., merits and demerits

4. **Combustion in S. I. Engines:** Stages of combustion, Ignition lag, Flame propagation, Factors affecting flame speed, Abnormal combustion, Influence of engine design and operating variables on detonation, Fuel rating, Octane number, Fuel additives, HUCR, Requirements of combustion chambers of S.I. Engines and its types.

5. **Supercharging and Turbo-charging:** Necessity of supercharging, Thermodynamic cycle, Types of superchargers, Turbo charging, methods of turbo-charging Limitations of supercharging for S.I. and C.I. Engines.

6. **Fuel Systems for C.I. Engines:** Requirements of injection system, Types of injection systems - Individual pump, Common rail and Distributor systems, Unit injector, Types of fuel nozzles- single hole, multi hole, pintle, and pintaux, Formation of Spray, Atomization and penetration. Governing of C.I. engines. Electronic diesel injection system. Calculations of main dimension of fuel injection system.

7. **Combustion in C.I. Engines:**
Stages of combustion, Delay period, Factors affecting delay period, Abnormal combustionDiesel knock, Influence of engine design and operating variables on diesel knock, Comparison of abnormal combustion in S I and C I engines, Cetane number, Additives. Requirements of combustion chambers for C.I.engines and its types.

8. **Performance Testing of Engines:** Performance parameters, I. S. Standard Code10000 (I to XI) to 10004 for testing of engines), Measurement of performance parameters like torque, power, Volumetric Efficiency, Mechanical Efficiency, BSFC, Brake and Indicated Thermal efficiencies. Numerical on Heat Balance Sheet & engine performance, Performance curves.

9. **Alternative Fuels for I.C. engines:** Alternative fuels for S. I. Engines & C. I. engines, S.I. engine operation using LPG, alcohol and hydrogen fuels. C.I. engine operation using CNG, bio-gas, bio diesels.

10. **Engine Emission and Control:** S.I. engine emission (HC, CO, NOx) Control methods- Evaporative (ELCD), Thermal, Catalytic converters, C.I. Engines Emission (CO, NOx, Smog, Particulate), Control methods- Chemical, EGR, Standard pollution Norms like EURO, Bharat.

11. **Engine Selection:** Selection of an I.C. engine for Automotive, Locomotive, Aircraft, Marine, Agriculture, and Power generation based on criteria such as operating cycle, fuel used, cooling method, cylinder numbers & arrangement, speed, fuel economy and power to weight ratio.

Text Books:-

1. *Willard W. Pulkrabek, Engineering Fundamentals of Internal Combustion Engines, Pearson Education Asia, N. Delhi.*
2. *V.P. Vasandani & D.S. Kumar, Heat Engineering, Metropolitan Book Co.*

Reference Books:-

1. *John B. Heywoold. I.C. Engine, M.cGraw-Hill.*
2. *Joel, Basic Engineering Thermodynamics, Pearson Education Asia.*
3. *Granet, Thermodynamics & Heat Power, Pearson Education Asia.*
4. *M.L. Mathur & R.P. Sharma, A Course in I.C. Engine, Dhanpat Rai & Sons, N.D.*

4.2 ENVIRONMENTAL STUDIES

Multidisciplinary nature of environmental studies: Definition, scope and importance, Need for public awareness.

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

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

Biodiversity and its conservation: Introduction – Definition : genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. Inida as a mega-diversity nation. Hot-sports of biodiversity. Threats to biodiversity - habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity - In-situ and Ex-situ conservation of biodiversity.

Environmental Pollution: Definition, Cause, effects and control measures of :- Air pollution; Water pollution; Soil pollution; Marine pollution; Noise pollution; Thermal pollution; Nuclear hazards and solid waste Management : Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.. Pollution case studies. Diaster management : floods, earthquake, cyclone and landslides.

Social Issues and the Environment: From Unsustainable to Sustainable development; Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Resettlement and rahabilitation of people; its problems and concerns. Case Studies;Environmental ethics : Issues and possible solutions;Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act; Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public awareness.

Human Population and the Environment: Population growth, variation among nations; Population

explosion – Family Welfare Programme., Environment and human health; Human Rights. Value Education; HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health.

Field work : Visit to a local area to document environmental assets river/forest/ grassland/hill/ mountain; Visit to a local polluted site-Urban/Rural/Industrial/Agricultural; Study of common plants, insects, birds; Study of simple ecosystems-pond, river, hill slopes, etc. (**Field work = 5 lecture hours)**

(**NOTE**: Syllabus for Environment Studies includes class room teaching and Field Work. The syllabus is divided into eight units covering 50 lectures. The first seven units will cover 45 lectures which are class room based to enhance knowledge skills and attitude to environment. Unit eight is based on field activites which will be covered in five lecture hours and would provide student first hand knowledge on various local environmental aspects. Field experience is one of the most effective learning tools for environmental concerns. This moves out of the scope of the text book mode of teaching into the realm of real learning in the field, where the teacher merely acts as a catalyst to interpret what the student observes or discovers in his/her own environment. Field studies are as essential as class work and form an irreplaceable synergistic tool in the entire learning process.)

Text Book:-

1. *Mhaskar A.K., Matter Hazardous, Techno-Science Publication*
2. *Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. Clark R.S., Marine Pollution, Clanderson Press Oxford*
3. *Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication*
4. *Agarwal, K.C. Environmental Biology, Nidi Publ. Ltd. Bikaner.*

Reference Books:-

1. *Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)*
2. *Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. Environmental Encyclopedia, Jaico Publ. House, Mumabai,*
3. *De A.K., Environmental Chemistry, Wiley Eastern Ltd.*

4.3 KINEMATICS OF MACHINES

Motion Analysis: Kinematics links, Pairs and chains, Type of motions, Type of mechanisms, Inversion of mechanisms, Velocity analysis of different mechanism by vector and instantaneous method, Acceleration analysis of different mechanism, Coriolis acceleration.

Gear Drives: Law of Gearing, Types of gears, Gear terminology, Gear Trains, Types and applications of gear trains, Train value, Analysis of Simple, Compound, Inverted and Epicyclical gear trains.

Cam Mechanism: Types of Cams and Followers, Types of follower motions, Construction of cam profiles, Analysis of motion of follower, Operating different types of cam. Steering Mechanism, Hook's Joint.

Synthesis: Introduction to Synthesis of mechanisms.

Text Books:-

1. *Rattan, S.S., Theory of Machines, McGraw Hill (2005) 2nd ed.*
2. *Bevan, T., Theory of Machines, Longman's Green & Company (2005) 3rd ed.*

Reference Books:-

1. *Ghosh, A. and Malik, A.K., Theory of Mechanism and Machines, Affiliated East West Press (2000) 3rd ed.*
2. *Shigley, J.E., Kinematic Analysis of Mechanisms, McGraw-Hill (1995) 2nd ed.*
3. *Myszka, D.S., Machines & Mechanisms: Applied Kinematic Analysis, Prentice Hall of India (2006) 3rd ed.*

4.4 MATERIAL SCIENCE & METALLURGY

Metallurgy: Introduction to Engineering materials, their mechanical behaviour, testing and manufacturing properties of materials, physical properties of materials, classification of engineering materials, elementary consideration of structures of metals, space lattices, crystal systems allotropy, general principles of phase transformation in alloys, phase rule and equilibrium diagrams, solidification of metals, cooling curves, phase rule, solid solution, eutectic and peritectic, equilibrium diagrams of binary system, ferrous alloys (steel, cast iron) and non-ferrous metals and alloys (copper, aluminum, magnesium, nickel, zinc, and lead – base alloys), bronze, brass, bearing materials, iron carbon equilibrium diagram, phase transformation, time temperature transformation curves, critical temperatures on heating and cooling, equilibrium structures – annealing, normalizing, martensitic transformation and tempering isothermal transformation diagrams, quenching, harden ability and harden ability tests, interrupted quenching, surface hardening processes, defects in heat treatment and their remedies; effects produced by alloying elements on the structures and properties of steel, composition of alloy steels, brief outlines of oxygen steel making.

Mechanical measurement: Need and classification of measurements and instrument, measurement systems, Mechanical versus electrical /electronic instruments, Classification of Errors, Range and span, accuracy and precision, calibration, hysteresis and dead zone, sensitivity and linearity, threshold and resolution; speed of response, lag, fidelity and dynamic error, dead time and dead zone, electro-mechanical sensors and transducers - variable resistance, inductance and capacitive pick ups, photo cells and piezo-electric transducers and application of these elements for measurement of position / displacement, speed / velocity / acceleration, force and liquid level, Resistance strain guages, guage factor, bonded and unbonded gauges, surface preparation and bonding technique signal conditioning and bridge circuits, temperature compensation, application of strain guages for direct, bending and torsional loads, Introduction to amplifying, transmitting and terminating devices, Mechanical tachometers, vibration reed tachometer and stroboscope; proving ring, hydraulic and pneumatic load cells, torque on rotating shafts; Absorption, transmission and driving dynamo meters.

Metrology: Line, end and wavelength standards; linear measurements - vernier scale and micrometer, vernier height gauge and depth guage; comparators - their types, relative merits and limitations; Angular measurements - sine bar, clinometer, angle guage; concept and measurement of straightness and flatness by interferometry; surface roughness - specifications and measurement by Talysurf, Measurement of major diameter, minor diameter, effective diameter, pitch, angle and form of threads for internal and external threads; measurement of tooth thickness, pitch and checking of profile for spur gears, Laser Metrology, Tool Makers Microscope, Profile Projector, Coordinate Measuring Machine.

Text Books:-

1. *Y. Lakhin, Engg. Physical Metallurgy Mir Publishers*
2. *B. Zakharv, Heat treatment of metals B. Zakharv*
3. *V. Raghavan, Engineering Metallurgy*
4. *D.S. Kumar D.S., Mechanical measurement and control*
5. *Jain R. K. ,Engineering Metrology by- R. K. Jain*
6. *Mahajan M, Metrology*

Reference Books:-

1. *Avner S.H., Introduction to Physical Metallurgy, McGraw Hill.*
2. *Van Vlack L.H., 'Elements of Material Science and Engineering', John Wiley.*
3. *Antony, D.M., Engineering Metrology, Pergamon Press.*

4.5 MECHANICS OF DEFORMABLE BODIES

Three-Dimensional Stress Analysis: Stresses on an arbitrary plane, Principal stresses and stress invariant, Mohr's stress circles, Differential equations of equilibrium in Cartesian and cylindrical coordinates, Three-dimensional strain analysis, Rectangular strain components, Principal strains and strain invariant, Compatibility conditions.

Stress-Strain Relations: Generalized Hooke's law, Stress-strain relations for isotropic materials.

Energy Methods: Principle of superposition, Work done by forces- elastic strain energy stored, Maxwell-Betti's theorem, Castigliano's theorems, Strain energy expressions, Fictious load method, Statically indeterminate problems.

Unsymmetrical Bending: Flexure formula for unsymmetrical bending, Shear centre and its determination for various sections.

Curved Flexural Members: Winkler-Bach formula, Stresses in curved beams having rectangular, Circular and trapezoidal sections, Stresses in rings and chain links.

Torsion of Non-circular Members: Torsion of prismatic bars, Elastic membrane analogy, Torsion of sections composed of narrow rectangles, Thick Cylinders and Rotating Discs, Lame's theory for stresses in thick cylinders, Composite tubes, Shrink fits and Laminated cylinders, Thin rotating rings, Stresses in rotating discs and cylinders, Discs of uniform strength.

Helical Springs: Analysis of closely coiled and open coiled helical springs subjected to axial load and moment, Stresses and deflections in springs.

Elastic Stability: Euler's buckling load, Beam-column equations, Beam column with concentrated load, Critical load for columns with different end conditions.

Theories of Elastic Failure: Various theories of failure, Significance and applications, Graphical comparison for plane stress case.

Text Books:-

1. *Srinath, L.S., Advanced Mechanics of Solids, TMH*
2. *Kumar K. and Ghai, R. C., Advanced Mechanics of Materials, Khanna Publishers*

Reference Books:-

1. *Shames, I.H., Mechanics of Deformable Solids, PHI*
2. *Popov, E.P., Engineering Mechanics of Solids, PHI*
3. *Ryder, G.H., Strength of Materials, B.I. Publishers*

4.6 INDUSTRIAL ENGINEERING

1. **Introduction:** Definition and scope of industrial engineering Role of an industrial engineering Role of an industrial engineer in industry, Functions of industrial engineering department and its organization, Qualities of an industrial engineer.
2. **Plant Layout and Material Handling**: Different types of layouts viz. Product, process and combination layouts, Introduction to layouts based on the GT, JIT and cellular manufacturing systems, Development of plant layout. Types of material handling equipment, relationship of material handling with plant layouts.
3. **Work-study:** Areas of application of work study in industry; Method study and work measurements and their inter-relationship. Reaction of management and labour to work study; Role of work study in improving plant productivity and safety.
4. **Method Study** : Objectives and procedure for methods analysis: Select, Record, Examine, Develop, Define, Install and Maintain. Recording techniques, Micromotion and macro-motion study: Principles of motion economy, Normal work areas and work place design.
5. **Work Measurement** : Objectives, Work measurement techniques - time study, work sampling, pre-determined motion time standards (PMTS) Determination of time standards. Observed time, basic time, normal time, rating factors, allowances, standard time.
6. **Value Engineering** : Types of values, concept of value engineering, phases of value engineering studies, application of value engineering.
7. **Work design** : Concepts of job enlargement, job enrichment and job rotation.Effective job design considering technological and behavior factors.
8. **Ergonomics** : Introduction to ergonomic considerations in designing man-machine systems with special reference to design of displays and controls.

Text Books

1. Introduction to Work study by Gayler Shotbolt
2. Industrial Engineering & Management by Hicks, Tata McGraw Hill, New Delhi
3. Product Design and Development by Ulrich, Tata McGraw Hill, N. Delhi
4. Work study and Ergonomics by Suresh Dalela and Saurabh, Standard Publishers.
5. Motion and time study by R. Bernes, John-Wiley & Sons
6. Ergonomics at work, by D.J. Oborne, John Wiley & Sons.
6. Techniques of Value Analysis and Engineering by Miles, McGraw Hill.

4.7COMPUTER AIDED DRAFTING LAB

1. Learn the basic initial setting and viewing of the drafting software's interface.
2. Learn the basic options of drawing aids like grid, snap, ortho etc. and other aids for distance and mass properties calculations
3. Learn and draw the basic entities in 2D
4. Learn and use the various modify commands of the drafting software
5. Learn and use the layers and blocks in drafting software
6. Use hatching and dimensioning to detail out a component drawings
7. Understand different coordinate system and do a exercise on drafting software using this
8. Draw the different types of 3D modeling entities using viewing commands to view them
9. Draw the different Surface model with different editing commands
10. Learn and use shading and rendering techniques for better visual appearance
11. Use and learn import/export techniques and customization of drafting software

4.8 THERMODYNAMICS -II LAB

1. To Study 2 stroke and 4 stroke Petrol and Diesel engines

2. To draw valve timing diagram of a diesel engine and study of its impact on the performance of an IC Engine.

3. Study of various circuits of a carburetor fitted on Indian Make Vehicle.

4 Determine the brake power, indicated power, friction power and mechanical efficiency of a multicylinder petrol engine running at constant speed (Morse Test).

5. Performance of a diesel/ semi diesel engine from no load to full load (at constant speed) for a single cylinder/ multi- cylinder engine in terms of brake power, indicated power, mechanical efficiency and SFC (Specific fuel consumption) and further obtain power consumption curves and draw the heat balance sheet.

E. FIFTH SEMESTER

5.1 DYNAMICS OF MACHINES

Force Analysis: Static and dynamic force analysis of mechanisms.

Flywheel: Turning moment diagrams, Fluctuation of energy, Coefficient of fluctuation of energy and speed, Application in engines and punching presses.

Belts Ropes and Chain Drives: Types of belt drives, Velocity ratio, Slip, belt length, Crowning of pulleys, V-belts, Condition for transmission of maximum power, Centrifugal tension, Chain drive, Types of chains, Merits and demerits of chain drive over belt drive, Expression for chain length, Chordal action.

Friction Devices: Fundamentals of friction, Pivots and Collars, Plate and Cone Clutches, Centrifugal Clutches, Friction in mechanism.

Brakes and Dynamometers: Short shoe brakes, Pivoted shoe brakes, Long shoe brakes, Band brakes, Different types of Dynamometers.

Governors: Function, Types, Force analysis, Characteristics.

Gears: Law of gearing, Tooth profiles, Interference, Minimum number of teeth on gear and pinion to avoid interference, Path of contact and arc of contact, Force analysis of spur, Helical, Bevel and worm gears, Efficiency of gears.

Balancing: Balancing of rotating and reciprocating masses, Balancing of inline and v-engines.

Gyroscope: Gyroscopic effect, Application in ships, Vehicles etc.

Text Books:-

1. *Rattan, S.S., Theory of Machines, Tata McGraw Hill (2005).*
2. *Bevan, T., Theory of Machines, C.B.S. Publications (2005) 3rd ed.*

Reference Books:-

1. *Ghosh, A. and Malik, A.K., Theory of Mechanism and Machines, Affiliated East West Press (2000) 3rd ed.*
2. *Shigley, J.E., Kinematics Analysis of Mechanism, McGraw Hill (1995).*

5.2 MACHINE DESIGN-1

Objectives

1. Understand the meaning of machine design and basic design process
2. Understand the various types of machine design processes
3. Developing creativity for design
4. Co-relating the basic machine design with the of product design process
5. Developing the capability to analyse and select the various criteria of design
6. To be able to segregate components and design them independently.
7. Predict effectively and accurately the reasons of failure and then correlate it to the theoretical knowledge.
8. To learn various design consideration like stress concentration factor, factor of safety etc.
9. Design of various types of fasteners including riveted joints, bolted joints and welded joints under various loading conditions.
10. Design of transmission shafts subjected to torque, bending and axial loading
11. Design various kinds of keys for both shearing and crushing
12. Design rigid and flexible coupling for torque transmission
13. Learning of basic design of links and levers
14. Designing of some of the pipe joints

Detailed Contents

1. Meaning of design with special reference to machine design. Definition and understanding of various types of design, Elaborated Design process

2. Design and creativity ; Systematic design conceptualization, product design definition, underlying principles of design in Aesthetics and ergonomics, free body diagram for components design

3. **General Design Considerations:**

a) Concept of tearing, bearing, shearing, crushing, bending etc.

b) Selection of materials, Basic criteria of selection of material, their Designation, mechanical properties of those materials in brief.

c) Study of Stress concentration, factor of safety under different loading conditions,

4. Basic Design:

Design for static loading, design for variable loading for both limited and unlimited life, concept of fatigue and endurance strength.

5. Design of fasteners:

a) RIVETS: Desing of rivets for boiler joints, lozenge joints (uniform strength joint), eccentrically loaded riveted joints

b) BOLTS: Understanding the various stresses/ failure in bolted joints, design of cylindrical covers, basic and eccentrically loaded bolts

c) WELDS: Design for various loading conditions in torsion, shear or direct load, ccentrically loaded welded joints.

d) MISCELLENEOUS: Design of spigot and socket cotter joint, Gib and Cotter joint and knuckle joint.

5. **Design of Transmission Shaft**

Design of both solid and hollow shafts for transmission of torque, bending moments and axial forces, Design of shaft for critically speed, Design of shaft for rigidity and Design of stepped shafts for assembly

6. Design of Keys and Couplings:

Design of sunk keys under crushing and shearing, design of splines, design of sleeve and solid muff coupling, clamp or compression coupling, rigid and flexible flange coupling, design of universal joint

7**. Lever design:**

Basic lever design, design of foot and hand lever, cranked lever, bell crank lever, safety valve lever and shoe brake lever

8. Design of Pipe Joints:

Stresses in pipe joints, design of circular flange pipe joint, oval flanged pipe joints, square flange pipe joint

Text Books

1. Machine Design by Shigley Tata McGraw hill
2. Machine Design by Juvinal, John-Wiley Publishers
3. Machine Design by Spots, Prentice hall
4. Machine Design by Norton, Prentice Hall
5. Machine Design by Khurmi
6. Machine Design by Goyal and Bahl, Standard Publishers
7. Product Design and Development, Prentice Hall
8. Design Data Book Compiled by PSG College of Engineering & Technology, Coimbatore

5.3 MANUFACTURING PROCESS –I

CASTING PROCESSES

Introduction to metal casting types of patterns, their materials and allowances.

Moulding materials: Moulding sand compositions and moulding sand properties, sand testing types of moulds, moulding machines cores core sands, types of cores, core banking elements of gating system, and risers and their design. Cupola and its operation charge calculations types of furnaces,

Casting processes: sand casting, shell mould casting investment casting, permanent mould casting, full mould casting, vacuum casting. Die casting. Centrifugal casting, continuous casting.

Casting defects, their causes and remedies. Metallurgical considerations in casting, Solidification of metals and alloys, directional solidification, segregation, nucleation and grain growth, critical size of nucleus, Casting of copper alloys.

Cleaning and finishing of castings, Testing and Inspecting of castings.

WELDING

Welding introduction and classification of welding, processes, welding terminology, general principles, welding positions, filler metals. Gas welding and gas cutting, principle, oxyacetylene welding equipment Oxyhydrogen welding. Flame cutting. Electric are welding. Principle, equipment, types- MIG, TIG submerged arc and others.

Welding electrodes, classification and selection of electrodes, welding arc and its characteristics, arc stability, arc blow. Thermal effects on weldment. Heat affected zone grain size and its control.

Resistance welding- principle and their types i.e. spot, seam, projection, upset and flash Thermit welding, electro slag welding, friction welding, plasma are welding electron beam welding, atomic hydrogen hydrogen welding. Basic considerations in joint design, Welding defects, their cases and remedies.

Brazing, braze welding and soldering.

Text Books

1. Heine, R.W. C.R. Loper and P.C. Rosenthal, Principles of metal casting Mc Graw Hill New York- 1967
2. Welding Technology by R.S. Parmar, Khanna Publishers.

5.4 HEAT AND MASS TRANSFER

1. Introduction

Concept of heat transfer, Difference between the subject of "Heat Transfer" and its parent subject "Thermodynamics". Different modes of heat transfer - conditions, convection, radiation.

2. Conduction

Fouier's law of heat conduction, coefficient of thermal conductivity, effect of temperature and pressure on thermal conductivity of solids, liquids and gases and its measurement.

Three-dimensional general conduction equation in rectangular, cylindrical and spherical coordinates involving internal heat generation and unsteady state conditions. Derivation of equations for simple one dimensional steady state heat conduction from three dimensional equations for heat conduction though walls, cylinders and spherical shells (simple and composite), electrical analogy of the heat transfer phenomenon in the cases discussed above. Equivalent areas, shape factor, conduction through edges and corners of walls and critical thickness of insulation layers on electric wires and pipes carrying hot fluids. Internal generation cases along with some practical cases of heat conduction like

heat transfer through underground electrical cables, simple model of heat conduction

through piston crown and case of nuclear fuel rod with cladding. Influence of variable thermal conductivity on conduction through simple cases of walls / cylinders and spheres. Introduction to unsteady heat transfer, Newtonian heating and cooling of solids; definition and explanation of the term thermal diffusivity.

3. Theory of Fins

Straight rod type of fins of uniform cross-section; e.g. of circular, rectangular or any

other cross-section). Straight fins with varying cross-sectional area and having triangular or trapezoidal profile area, circumferential find of rectangular cross-section provided on the circumference of a cylinder. Optimum design of straight find of rectangular and triangular profile cross-sections; fin effectiveness and fin efficiency for straight rod fins of rectangular and circular cross-section. Application of fins in temperature measurement of flow through pipes and determination of error in its measurement.

4. Convection Free and forced convection, derivation of three-dimensional mass, momentum and energy conservation equations (with introduction to Tensor notations).

Boundary layer formation, laminar and turbulent boundary layers (simple explanation only and no derivation).

Theory of dimensional analysis as applied to free and forced convective heat transfer. Analytical formula for heat transfer in laminar and turbulent flow, flow over vertical and horizontal tubes and plates.

Newton's law of cooling. Overall coefficient of heat transfer. Different design criterion for heat exchangers. Log mean temperature difference for evaporator and condenser tubes, and parallel and counter flow heat exchangers. Calculation of number and length of tubes in a heat exchanger.

5. **Convection with Phase Change (Boiling and Condensation)**

Pool boiling, forced convection boiling, heat transfer during pool boiling of a liquid. Nucleation and different theories of nucleation, different theories accounting for the increased values of h.t.c. during nucleate phase of boiling of liquids; different phases of flow boiling (theory only)

6. Radiation

Process of heat flow, definition of emissivity, absorptive, reflectivity and transmissivity. Concept of black and grey bodies, Plank's law of nonchromatic radiation. Kirchoff's law and Stefan Boltzman's law. Interchange factor. Lambert's Cosine law and the geometric factor. Intensity of Radiation (Definition only), radiation density, irradiation, radiosity and radiation shields.

Derivation formula for radiation exchange between two bodies using the definition of radiosity and irradiation and its application to cases of radiation exchange between three or four bodies (e.g. boiler or other furnaces), simplification of the formula for its application to simple bodies like two parallel surfaces, concentric cylinders and a body enveloped by another body etc. Error in Temperature measurement by a thermocouple probe due to radiation losses.

Text Books

1Fundamentals of Heat and Mass transfer by DS Kumar, SK Kataria and Sons, Delhi
2. A Course in Heat and Mass Transfer by S Domkundwar; Dhanpat Rai and Sons, Delhi
3. Heat Transfer by AJ Chapman; Macmillan Publishing Company, New York
4. Heat transfer by JP Holmans, McGraw Hill, London
5. Fundamentals of Heat and Mass transfer by Frank P Incropera and David P De Witt, John Wiley and Sons

5.5 MECHANICAL MEASUREMENTS AND METROLOGY

Detailed Contents

1**. General Concepts**

Need and classification of measurements and instruments; basic and auxiliary functional elements of a measurement system; Mechanical versus electrical / electronic instruments; primary, secondary and working standards.

2. Static and Dynamic Characteristics of Instruments

Range and span, accuracy and precision, calibration, hysteresis and dead zone, sensitivity and linearity, threshold and resolution; speed of response, lag, fidelity and dynamic error, dead time and dead zone. Zero, first and second order systems and their response to step, ramp and sinusoidal input signals.

3. Errors in Measurement

Sources of errors, systematic and random errors; statistical analysis of test-data, probable error and probability tables, ejection of test data; curve fitting, error propagation; Design and planning of experiments and report writing.

4. Metrology

Line, end and wavelength standards; linear measurements - vernier scale and micrometer, vernier height gauge and depth guage; comparators - their types, relative merits and limitations; Angular measurements - sine bar, clinometer, angle guage; concept and measurement of straightness and flatness by interferometry; surface roughness - specifications and measurement by Talysurf, Measurement of major diameter, minor diameter, effective diameter, pitch, angle and form of threads for internal and external threads; measurement of tooth thickness, pitch and checking of profile for spur gears.

5. Functional Elements

Review of electro-mechanical sensors and transducers - variable resistance, inductance and capacitive pick ups, photo cells and piezo-electric transducers and application of these elements for measurement of position / displacement, speed / velocity / acceleration, force and liquid level. Resistance strain guages, guage factor, bonded and unbonded uages, surface preparation and bonding technique signal conditioning and bridge circuits, temperature compensation, application of strain guages for direct, bending and torsional loads. Introduction to amplifying, transmitting and terminating devices.

6. Pressure and Flow Measurement

Bourdon tube, diaphragm and bellows, vacuum measurement - Mcleod guage, thermal conductivity guage and ionisation guage; Dead weight guage tester. Electromagnetic flux meters, ultra-sonic flow meters and hot wire anemometer: flow visualisation techniques.

7. **Temperature Measurement**

Thermal expansion methods - bimetallic thermometers, liquid-in-glass thermeter and filled-in-system thermometers; thermo-electric sensors - common thermo couples, reference junction considerations, special materials and configurations; metal resistance thermometers and thermistors; optical and total radiation pyrometers; calibration standards.

8**. Speed, Force, Torque and Shaft Power Measurement**

Mechanical tachometers, vibration reed tachometer and stroboscope; proving ring, hydraulic and pneumatic load cells, torque on rotating shafts; Absorption, transmission and driving dynamo meters.

Text Books

1. Measurement System : Application and Design by Doebelin E.O; McGraw Hill Publishing Company.
2. Experimental Methods for Engineers by Holman JP; McGraw Hill Publication Company.
3. Mechanical Measurement and Control by Kumar DS; Metropolitan Book Co Pvt. Ltd., New Delhi.
4. Engineering Metrology by Jain RK
5. Automatic Control systems by Kuo BC; Prentice Hall

5.6 CAD /CAM

Course Objectives

1. Understand the applications and benefits of CAD
2. Understand the various computer hardware devices
3. Understand the various software used in CAD and the functions of a graphics package.
4. Understand geometric transformation.
5. Understand various representations of curves and surfaces.
6. Understand the various concepts and characteristics in geometric modeling.
7. Understand various data exchange formats.
8. Apply CAD techniques to finite element mesh generation.
9. Understand the basic concepts of CAM
10. Analyze the components and systems of NC and CNC machine tools.
11. Understand and apply various programming methods for specific jobs.
12. Understand the concepts of DNC and adaptive control
13. Understand the fundamentals and advantages of group technology.
14. Classify various CAPP systems.
15. Understand FMS and CIMS with reference to components, advantages and applications.

Detailed Contents:

Course contents

1. Fundamentals of CAD: Introduction: Design Process: Application of computers in design: Creating manufacturing database: benefits of CAD.
2. Computer Hardware; Graphic input devices; display devices; Graphics output devices; Central processing unit (CPU)
3. CAD software and Database: Software configuration of a graphics system: functions of a graphics package: geometric modeling: Database structure and control; Graphics standard: GKS and IGES.
4. Geometric Transformations: Mathematics preliminaries, matrix representation of 2 and 3 dimensional transformation: Concatenation of transformation matrices. Application of geometric transformations.
5. Representation of curves and surfaces: Polygon, meshed and ruled surfaces: Bezier curves; B-spline curves.
6. Geometric Modeling: Wireframe model: solid modeling: representation, volumetric properties, surface modeling, concepts of hidden-line removal and shading: Kinematics analysis and simulation.
7. Application of CAD techniques to finite Element Mesh Generation.

7. Introduction: Basic concepts of manufacturing system and CAD/CAM.

9. NC/CMNC Machine Tools; NC machine tools- basic components, coordinate systems; features of NC machine tools. Computerized Numerical Control (CNC): Tooling for NC machines - tool presetting equipment, flexible tooling, tool length compensation, tool path graphics; NC motion control system; Manual part programming, fixed/floating zero. Block format and codes: Computer assisted part programming. DNC and Adaptive Control: Direct numerical control: Adaptive control in machining system; Combined DNC/CNC system.

10. Group Technology (GT): Part families; part classification and coding system: Group technology machine cells: Advantages of GT.

9 Computer Aided Process Planning: Introduction and benefits of CAPP. Types of CAPP systems, machinability data selection systems in CAPP.

12. Flexible Manufacturing System (FMS) and Computer integrated manufacturing system: FMS and its advantages, components of a FMS system. Introduction to CIMS.

Text Books:

1. CAD/CAM by Groover & Simmers, Prentice Hall of India
2. Automation, Production Systems and computer integrated manufacturing by Groover, Prentice Hall of India
3. Computer Integrated Design and Manufacturing by D.D. Bedworth, M.R Henderson & P.M. Wolfe, Tata MCGraw Hill Pub. Co.
4. CAD/CAM - theory and Practice by Zeid Ibraham, Tata McGraw Hill Pub Co.

5.7 MACHINE DESIGN PRACTICE I

1. Select a daily use product and design the conceptual design by applying the design process talking the controlling parameters

2. Make a list of mechanical components and know their materials and suggest some alternative materials for the each on of them

3. Design a wall bracket, which is being used in real life by actual measurement of load

   a) Welded joints

   b) Riveted and bolted joints

And justify your findings

4. Find a flange coupling in the college laboratory and justify its design by actual measurements

5. Design a shaft used in some practical application, by actual working and loading conditions

6. Select a braking system lever (both hand and foot lever) and justify the design parameters

7. Justify the design of single plate clutch of a engine assembly

8. Design a software in some high level language or excel sheets for design of a component

5.8 HEAT AND MASS TRANSFER LABORTOARY

1. Determination of thermal conductivity of :
- a solid insulating material by slab method
- powder materials by concentric spheres method / or by some transient heat transfer technique
- a metal by comparison with another metal by employing two bars when kept in series and / or in parallel under different boundary conditions - Liquids by employing thin layer
2. Determination of coefficient of heat transfer for free/forced convection from the surface of a cylinder / plate when kept:
a) along the direction of flow
b) perpendicular to the direction of flow
c) inclined at an angle to the direction of flow
3. To plot the pool boiling curves for water and to determine its critical point
4. Determination of heat transfer coefficient for
i) film condendsation
ii) drop-wise condensation
5. Determination heat transfer coefficient by radiation and hence find the Stefan Boltzman's constant using two plates/two cylinders of same size by making one of the plates/cylinders as a black body.
6. Determination of shape factor of a complex body by an analog technique.
7. To plot the temperature profile and to determine fin effectiveness and fin efficiency for
i) A rod fin when its tip surface is superimposed by different boundary condition like.
a) Insulated tip
b) Cooled tip
c) Temperature controlled tip
ii) Straight transfer fins of various sizes and optimization of fin proportions
iii) Circumferential fins of rectangular/triangular section
8. evaluate the performance of a heat pipe
9. Fluidised bed heat transfer

5.9 MECHANICAL MEASUREMENT & METROLOGY LABORTOARY

1. Measurement with the help of vernier caliper and micrometer

2. Measurement of an angle with the help of sine bar

3. Measurement of surface roughness

4. Measurement of gear elements using profile projector

5. Three wire method to determine effective diameter of external threads

6. Measurement of thread element by Tool makers microscope

7. Calibration of a pressure guage with the help of a dead weight guage tester

8. Use of stroboscope for measurement of speed of shaft

9. Use of pilot tube to plot velocity profile of a fluid through a circular duct

10. Preparation of a thermocouple, its calibration and application for temperature measurement

5.10 CAD/CAM LABORTOARY

1. Learn the basic initial setting and viewing of the drafting software's interface.
2. Learn the basic options of drawing aids like grid, snap, ortho etc. and other aids for distance and mass properties calculations
3. Learn and draw the basic entities in 2D
4. Learn and use the various modify commands of the drafting software
5. Learn and use the layers and blocks in drafting software
6. Use hatching and dimensioning to detail out a component drawings
7. Understand different coordinate system and do a exercise on drafting software using this
8. Draw the different types of 3D modeling entities using viewing commands to view them
9. Draw the different Surface model with different editing commands
10. Learn and use shading and rendering techniques for better visual appearance
11. Use and learn import/export techniques and customization of drafting software

5.11 MANUFACTURING PROCESS – I LABORTOARY

CASTING PRACTICALS

1. To study ingredients of molding sand and core sand.
2. To determine clay content in a moulding sand sample.
3. To determine moisture content in a moulding sample.
4. To find shatter index of moulding sand sample.
5. To conduct hardness test for mould and core.
6. To test tensile, compressive, transverse strength of moulding sand in dry condition.
7. Determination of permeability of a moulding sand sample.
8. Measurement of grain finances number.
9. To study various features of cupola furnace and its charges calculations.
10. Prepare a green sand mould for any stable engg. component.

WELDING PRACTICALS

1. Specimen preparation and making of lap joint, Butt, T- joints with oxy- acetylene gas welding.
2. Making of lap, Butt, T- joints etc. with electric arc welding.
3. Study of MIG welding equipment and making a weld joint in this process.
4. Study of TIG welding equipment and making a weld joint in this process.
5. Study of different process parameters in Friction welding and preparing a weld joint by this process.
6. To study various welding equipments namely generators welding torch etc.
7. To study the resistance welding processes and prepare welded joint.

F.SIXTH SEMESTER

6.1 MACHINE DESIGN-II

1Review of principles of retainment, alignment and assembly, of various components of machines, various types of oil seals: friction lock and its applications in reciprocating cam-followers, assembly and link motions.

2. Study the layout of some existing transmission system design and suggest a new conceptual design by removing the shortcomings of the existing design

]3. Find an assembly containing the belt and pulley mechanism and do the complete design calculations and then justify the existing design.

4. Calculation of the velocity ratios required in a gear box and then design the gearbox in practical application (gearbox application must involve different types of gears like bevel, spur and helical gears)

5. Find a transmission system involving the worm an worm wheel and then find out the inputs required for its design and justify the design.

6. The gearbox design in the exp no. 5, Design the shafts required to support the assembly and design it for manufacturing and assembly.(with actual calculations of the loads and the end conditions)

7. For a press of your machine shop, study the process and suggest the design parameters of the flywheel required. Justify the design if flywheel is already there.

8. Design springs for practical application for the given conditions and constraints and find its practical availability.

9. Select a mechanical component or system, convert its design procedure into an algorithm and write a code for its design or with the help of an application software.

Text Books

1. Machine Design by Shigley Tata McGraw hill
2. Machine Design by Juvinal, John-Wiley Publishers
3. Machine Design by Spots, Prentice hall
4. Machine Design by Norton, Prentice Hall
5. Machine Design by Khurmi
6. Machine Design by Goyal and Bahl, Standard Publishers
7. Product Design and Development, Prentice Hall
8. Design Data Book Compiled by PSG College of Engineering & Technology, Coimbatore

6.2 REFRIGERATION & AIR CONDITIONING

1. **Basic Concept**

Natural and Mechanical refrigeration; Application of Refrigeration; Units of refrigeration and Coefficient of performance; Refrigeration effect, cooling capacity and COP of a refrigerator; heating effect, heating capacity and COP as heat pump; Reversed Carnot cycle and its limitations

2. **Bell Coleman Cycle and Aircraft Refrigeration**

Bell Coleman Cycle and its analysis; optimum COP and pressure ratio, necessity of air craft refrigeration - air cycle refrigeration systems and their comparison

3. **Vapour Compression Refrigeration Cycle**

Vapour compression cycle on P-V, P-H and T-S diagrams; Deviation of actual cycle from theoretical cycle; Compressor capacity and volumetric efficiency, Analysis of theoretical and actual vapour compression cycles; Effect of suction pressure, discharge pressure, subcooling, super heating and pressure drop in valves on performance and cooling capacity.

4. **Vapour Compression Refrigeration with Multiple Evaporators and Compressors**

Compound compression with single and multiple expansion valves, water intercooling and flash intercooling; multiple load systems with single and multiple expansion valves

5. **Vapour Absorption Refrigeration Cycle (No Mathematical Analysis)**

Principle of absorption system; components of the system; Desirable properties of absorption system refrigerant and absorbent; Aqua - ammonia absorption refrigeration system; Lithium Bromide - water absorption system; Theory of mixtures; temerature concentration and enthalpy concentration diagrams; comparison between absorption and compression systems; Electrolux refrigeration system.

6. **Refrigerants**

Classification and nomenclature of refrigerants; Desirable thermodynamic, chemical and physical properties of refrigerants; comparative study of commonly used refrigerants and their fields of application; Azeotropes; Effect of moisture and oil miscibility; Refrigerants dying agents and antifreeze solution; leak detection and charging of refrigerants; environmental aspects of conventional refrigerants; Ecofriendly refrigerants and action plan to reduce ecological hazards.

7. **Non-Conventional Refrigeration Systems (No Mathematical Analysis)**

Steam Jet Refrigeration; Cascade Refrigeration System; Mixed Refrigeration Systems; Vortex Tube Refrigeration, Thermoelectric cooling; Linde and Claude cycles, cryogenics and its engineering applications.

8. **Air Conditioning Concept and Applications;**

Psychometric properties of air; Dry bulb, wet bulb and dew point temperatures; Relative and specific humidity; degree of saturation adiabatic saturation temperature, enthalpy of air and water vapours; psychometric chart. Human requirement of comforts; effective temperature and comfort charts; Industrial and comfort air conditioning.

9. **Psychometric Processes**

Sensible heating and cooling, cooling with dehumidification; Heating with dehumidification; by-pass factor; chemical dehumidification; adiabatic mixing, air washer.

10. **Calculations for Air** –conditioning Load and for Rate and state of Supply Air

Sources of heat load; sensible and latent heat load; sensible heat factor; apparatus dew point temperature; Rate and state of supply - air for air- conditioning of different types of premises.

11. **Refrigeration and Air Conditioning Equipment**

Brief description of compressors, condensers, evaporators and expansion devices; Cooling towers; Ducts; dampers; grills; air filters; fans; room air conditioners; split units; Package and central air conditioning plants.

Text Books

1. Refrigeration and Conditioning by CP Arora, Tata McGraw Hill
2. Refrigeration and Conditioning by Manohar Prasad, Wiley Eastern Limited
3. Refrigeration and Conditioning by Jordan and Priester, Prentice Hall of India
4. Refrigeration and Conditioning by WF Stoecker, McGraw

6.3 FLUIDS MECHANICS-II

1. **General Concepts**
Impulse momentum principle; jet impingement on stationary and moving flat plates, and on stationary or moving vanes with jet striking at the centre and tangentially at one end of the vane; calculations for force exerted, work done and efficiency of jet. Basic components of a turbo machine and its classification on the basis of purpose, fluid dynamic action, operating principle, geometrical features, path followed by the fluid and the type of fluid etc. Euler's equation for energy transfer in a turbomachine and specifying the energy transfer in terms of fluid and rotor kinetic energy changes.

2. **Pelton Turbine**
Component parts and operation; velocity triangles for different runners, work output; Effective head, available power and efficiency; design aspects such as mean diameter of wheel, jet ratio, number of jets, number of buckets with working proportions

3. **Francis and Kaplan Turbines**
Component parts and operation velocity triangles and work output; working proportions and design parameters for the runner; Degree of reaction; Draft tubes - its function and types. Function and brief description of commonly used surge tanks.

4. **Centrifugal Pumps**
Layout and installation; Main elements and their functions; Various types and classification; Pressure changes in a pump - suction, delivery and manometric heads; vane shape and its effect on head-capacity relationships; Departure from Euler's theory and losses; pump output and efficiency; Minimum starting speed and impeller diameters at the inner and outer periphery; Priming and priming devices, Multistage pumps - series and parallel arrangement; submersible pumps. Construction and operation; Axial and mixed flow pumps; Trouble shooting - field problems, causes
and remedies.

5. Similarity Relations and Performance Characteristics
Unit quantities, specific speed and model relationships, scale effect; cavitation and Thoma's cavitation number; Concept of Net Positive Suction Head (NPSH) and its application in determining turbine / pump setting

6. **Reciprocating Pumps**: -- Components parts and working; pressure variations due to piston acceleration; acceleration effects in suction and delivery pipes; work done against friction; maximum permissible vacuum during suction stroke; Air vessels

7. **Hydraulic Devices and Systems**
Const., operation and utility of simple and differential accumulator, intensifier, fluid
coupling and torque converter, Air lift and jet pumps; gear, vane and piston pumps.

Text Books

1. Hydraulic Turbines by Daughaty RL; McGraw Hill Book Co.
2. Hydraulic Machines by Jagdish Lal; Metropolitan Book Co Pvt. Ltd.
3. Fluid Mechanics and Fluid Power Engineering by Kumar DS; SK Kataria and Sons, Delhi

6.4 MANUFACTURING PROCESSES-II

1. **Metal Forming**

Introduction : Classification of forming processes,
Rolling : Classification of rolling processes, rolling mills, products of rolling and main variables, rolling defects,
Drawing : Drawing of rods, wires and tubes, Draw benches, main variables in drawing operations.
Forging : Open and closed die forging, forging operations, hammer forging, press forging and drop forging, forging defects, their causes and remedies.
Extrusion : Classification of extrusion processes, extrusion equipment, variables in extrusion process.
Introduction to high velocity forming.
Sheet metal forming operations : Spinning, deep drawing, bending.
Introduction to press working. Types of presses, press working operation, Press working tools.
Introduction to powder metallurgy, methods of producing powders, briquetting and sintering, sizing and finishing operations,

2. **Metal cutting and Machine tools**

Cutting tool materials, high carbon steels, alloy carbon steels, high speed steel, cast alloys, cemented carbides, ceremics and diamonds, CBN etc. Geometry of single point cutting tools, Twist Drill and milling cutter, cutting speeds and feeds Coolants: Classification, purpose, its effect on speed and feed
Lubricants: Function and properties
Lathe: Machine and its accessories, Lathe operations, Turning, Taper Turning and Thread cutting, kinematic scheme of lathe, shaping and planing Machine, Drive Mechanisms, slotting machine, cutting speeds and feeds Milling machine and its classification, upmilling and down milling
Indexing: Simple compound and differential
Sawing Machine and Drilling Operation
Boring Operation and boring machines
Grinding: Cylindrical, surface and centreless grinding
Composition and nomenclature of grinding wheels
Introduction to broaching machine

Text Books

1. Manufacturing Technology: Foundry, Forming and Welding by Rao, Tata McGraw Hill, New Delhi.
2. Principles of Manufacturing Materials and Processes by J.S. Campbell, Tata McGraw Hill.
3.Metal forming fundamentals and applications by Alton.

6.5 MECHATRONICS

The integration of Electronics Engineering, Electrical Engineering and Computer Technology & Control Engineering with Mechanical Engineering is increasingly forming a crucial part in the design, manufacture and maintenance of a wide range of engineering products and processes. A consequence of this is a need for engineers and technicians to adopt an interdisciplinary and integrated approach to engineering. Mechatronics is a term used to describe this integrated approach. This course is designed to provide a background to Mechatronics and to provide links through to more specialized skills.

Introduction To Mechatronics: Mechatronics case study, introduction to the Mechatronics Engineering Laboratory. (3 hours)

Review Of Basic Electronics: Ohm's law, semiconductors (PN junction diodes, AC rectification, Zener diode), Power supplies(3 hours)

Principles And Applications Of Transistors And Operational Amplifier Transistor (common emitter characteristics, emitter, follower circuit, FET); thyristor, triac, operational amplifiers (inverting, unity gain, non-inverting, C/V and V/C amplifiers, differential amplifier, instrumentation amplifier). (6 hours)

Digital Electronics : Boolean algebra; digital electronic gates; combination logic systems (simple gates, NAND and NOR gates, latches, positive and negative logic, tri-state logic); sequential logic systems (J-K flip-flop, registers and counter, timers and pulse circuits). (6 hours)

Sensor And Transduce: Principles And Applications: Introduction to sensors and transducers; general transducer characteristics (performance characteristics, static and dynamic characteristics); calibration; signal conditioning.

Sensor and Transducer applications Measurement of : angular position, linear displacement, rotational speed, force, pressure, strain, flow rate, temperature. (8 hours)

Drive Technology- Principles And Applications : Physical principles; solenoid-type devices; DC machines; AC machines; stepper motors.

Drive Technology Applications: Linear motors; voice coil motors; electro-pneumatic and electro-hydraulic actuators. (6 hours)

Elector Mechanical System- Principles And Applications : Rotary to linear motion conversion; power transmission Electromechanical System Applications, Coupling; gearing; belts; pulleys; bearings (5 hours)

A/D, D/A Conversion: Basic Principle Only. (2 Hours)

Introduction To Programmable Logic Controllers: PLC Hardware, PLC Memory structure, Basic application (5 hours) Microprocessor And Microcontroller Basic Operation Microcontroller applications (5 hours)

Text Book:-

1. *Bolton W, "Mechatronics" Pearson Education*
2. *Book by H M T Limited, Mechatronics TMH*

References Books:-

1. *Dan Necsulescu Mechatronics Pearson Education (Singapore) Pvt. Ltd.,*
2. *Nitaigour P Mahalik "Mechatronics Principles, Concepts & Applications" TMH. Alciatore et. Al,"Introduction to Mechatronics & Measurement Systems" TMH*

6.6 INSTRUMENTATION & CONTROL

1. Static performance characteristics and Data Analysis

Static performance parameters, Errors and uncertainties in performance parameters, propagation of uncertainties in compound quantities, statistical treatment of data, curve fitting, least square method for linear data, Quadratic Data.

2. Dynamic Characteristics of Instruments

Measuring system components and their functions, System equations formulation of system equations, Types of Input signals, Dynamic response of 1st order system and second order system to input. Transducers: Analog & Digital.

3. Electronics Measuring Instruments

Electronics multiuser, digital voltmeter, Frequency Counters, Special purpose oscilloscope, recording instruments, Telemetry and data acquisition syste.

4. Force Measurement and Pressure Measurements

Balance, hydraulic load cell, pneumatic load cell, Elastic force devices. Use of Strain Gage in load cell. Separation of force components, calibration. Torque and power measurement; Transmission dynamometers, Driving type dynamometers, absorption dynamometers. Moderate Pressure measurement, high pressure measurement, low pressure measurement, calibration and testing

5. Temperature and Flow Measurements

Temperature scale, Measurement of temp. non electrical method, electrical method and Radiation methods. Primary or quantity meters, secondary or rate meters, special methods of flow measurements.

6. Control Engineering Application

Classification of control system, Transfer transfer function of elements, system and process, Actuators, process/system, Response of control system, Stability of control systems

Text Books:

	Author	Title	Publisher
1.	A.K. Sawhney	Mechnaical Measurment & Instrumentation	Dhanpat Pai & sons, NewDelhi
2.	R.V. Jalgaonkar	Mechnical Measurement & Control	Everest Publishing House, Pune
3.	D.S.Kumar	Mechanical Measurement & Control	Metropolitan Publication, NewDelhi
4.	C.S.Narang	Instrumentation Devices & system	Tata McGraw hill Publication
5.	R.K. jain	Mechnaical & Industrial Measurement	Khanna Publication, NewDelhi
6.	B.C Nakra & K.K. Chaudhry	Instrumentation, Measurent and Analysis	Tata McGraw Hill Publication

6.7 FLUID MECHANICS- 2 LABORTARY

1. Determination of various efficiencies of Hydraulic Ram
2. To draw characteristics of Francis turbine
3. To study the constructional features of reciprocating pump and to perform test on it for determination of pump performance
4. To draw the characteristics of Pelton Turbine
5. To draw the various characteristics of Centrifugal pump
6. Determine the effect of vane shape and vane angle on the performance of centrifugal fan

6.8 MACHINE DESIGN PRACTICE LABORTARY

1. Review of principles of retainment, alignment and assembly, of various components of machines, various types of oil seals: friction lock and its applications in reciprocating cam-followers, assembly and link motions.
2. Study the layout of some existing transmission system design and suggest a new conceptual design by removing the shortcomings of the existing design
3. Find an assembly containing the belt and pulley mechanism and do the complete design calculations and then justify the existing design.
4. Calculation of the velocity ratios required in a gear box and then design the gearbox in practical application (gearbox application must involve different types of gears like bevel, spur and helical gears)
5. Find a transmission system involving the worm an worm wheel and then find out the inputs required for its design and justify the design.

6. The gearbox design in the exp no. 5, Design the shafts required to support the assembly and design it for manufacturing and assembly.(with actual calculations of the loads and the end conditions)
7. For a press of your machine shop, study the process and suggest the design parameters of the flywheel required. Justify the design if flywheel is already there.

8. Design springs for practical application for the given conditions and constraints and find its practical availability.
9. Select a mechanical component or system, convert its design procedure into an algorithm and write a code for its design or with the help of an application software.

6.9 REFRIGERATION & AIR CONDITIONING LAB

1. Study of various elements of a mechanical refrigerator system through cut sections models / actual apparatus
2. Study and performance of domestic refrigerator,
3. Study the performance of and Electrolux refrigerator
4. Study of an Ice plant and visit to cod storage for study
5. Calculation/ Estimation of cooling load for large building
6. Visit to a central Air conditioning plant for study of processes for winter and summer air conditioning
7. Study and performance of window type room air conditioner

6.10 MECHATRONICS LABORTARY

Teacher may design few experiments based on the facility available and the content of the subject no. 5 in sixth semester. The classes should be held in the Laboratory

6.11 MANUFACTURING PROCESSES-II LAB

1. Study of constructional features of following machines through drawings/ sketches:-
a) Lathe
b) Capstan & Turret Lathe
c) Radial drilling machine
d) Universal milling machine
e) Shaper and planer
f) Plastic moulding machine
g) Grinding machines (Surface, cylindrical)
h) Gear cutting machines etc.
i) Hydraulic Press
j) Draw Bench
k) Drawing, Extrusion Dies
l) Rolling Mills
2. Study of lubrication system in the machine tools.
3. Advanced exercises on Lathe where the students will work within specified tolerances, cutting of V- threads and square threads (internal as well as external).
4. Production of machined surfaces on shaper and planner.
5. Exercises on milling machines; generation of plane surfaces, production of spur gears and helical involute gears, use of end mill cutters.
6. Grinding of single point cutting tool, cutter and drills.
7. Study of recommended cutting speeds for different tool- work material combinations. Identification of different cutting tool and work materials.

G.SEVENTH/ EUGHTH SEMESTER

8.1 AUTOMOBILE ENGINEERING

1. **Introduction**

Basic structure, general layout and type of automotive vehicles, Frameless and nitary construction; position of power unit.

2. Power Unit

Power requirements - motion resistance and power loss, tractive effort and vehicle performance curves; selection of power unit and engine performance characteristics; pollution due to vehicle emission and exhaust emission control system.

3. Fuel Supply System

Air cleaner and fuel pumps; Air fuel requirements and carburation; Modifications in a simple carburettor to meet different starting, running, idling and accelerating consitions; constructional details of carburetors and fuel injection systems used in Indian make vehicles. Diesel fuel system - cleaning, injection pump, injector and nozzles.

4. Lubrication and Cooling Systems

Necessity of lubrication; Desirable properties of lubricants; various types of lubricants and oil additives; different systems of lubrication - oil filters, oil pumps and oil pressure indicator; crank case ventilation and dilution. Purpose of cooling, air and water cooling systems; radiator, thermostat, pump and fan.

5. Chassis and Suspension

Loads on the frame, considerations of strength and stiffness, engine mounting, conventional and independent suspension systems; shock absorbs and stablizers; wheels and tyres.

6. Transmission system

Basic requirements and standard transmission systems; constructional features of automobile clutch, gear box, differential, front and rear axles; overdrives, propeller shaft, universal joint and torque tube drive; Rear wheel vs front wheel drive, principle of automatic transmission

7. Steering System

Requirement and steering geometry; castor action, camber and king pin angle, toe-in of front wheels, steering linkages and steering gears; wheel alignment; power steering.

8. Braking System

General braking requirements; Mechanical, hydraulic, vacuum power and servo brakes; Weight transfer during braking and stopping distances

9. Electric System

Conventional (coil and magneto) and transistorized ignition systems; Charging, capacity ratings and battery testing; starter motor and drive arrangements : voltage and current regulation

10. Maintenance

Preventive maintenance, trouble shooting and rectification in different systems; engine turning and servicing

Text Books

1. Automotive mechanics by Crouse WH; McGraw Hill Publishing Co
2. Automotive Mechanics by Heitner J; East West Press
3. Automobile Engineering Vol I and II by Kirpal Singh, Standard Publishers

8.2 ELECTIVE I

1. ENTREPRENEURSHIP DEVELOPMENT

1.**CONCEPT OF LENTREPRENEURSHIP:**
Entrepreneurship and small scale industry, need for promotion of entrepreneurship, entrepreneurship development programmes (EDP), personality characteristics of entrepreneur.
2. **IDENTIFICATION OF INVESTMENT OPPORTUNITIES**
Governmental regulatory framework, industrial policy, industrial development and regulation act, regulation of foreign collaboration and investment, foreign exchange regulation act, incentives for export oriented units, incentives for units in industrially backward areas, incentives for small scale industry, government assistance to SSI, how to start and SSI, list of items reserved for SSI, Scouting for project ideas, preliminary screening, project identification for an existing company.
3. **MARKET AND DEMAND ANALYSIS:**
Information required for market and demand analysis, market survey, demand for ecasting, uncertainties demand forecasting.
4. **COST OF PROJECT AND MEANS OF FINANCING:**
Cost of project, means of financing, planning the capital structure of a new company, term loan financial institutions, cost of production.
5. **FINANCIAL MANAGEMENT:**
Concept and definition of financial management types of capital, of finance, reserve and surplus, concepts and liabilities, profit and loss statement balance sheet, depreciation, methods of calculating depreciation break even analysis and

Text Books:

1. E.D.I. Ahmedabad, Publication regarding Entrepreneurship.
2. Project Preparation, Appraisal Budgeting and Implementation, Prasanna chandra, TMH.
3. Entrepreneurship, TTTI
4. Entrepreneurial Development, C.S.Gupta & N.P.Srinivasan.
5. Entrepreneurship Development Practice & Planning, S.Chand.
6. Entrepreneurship of Small Scale Industries. M.U.Deshpanda C.B.I.

2. MAINTENANCE AND RELAIBILTY ENGINEERING

1.**Introduction:** Objective and characteristics of maintenance function; Organization of the maintenance system; Operating practices in maintenance. Maintenance record keeping.

2. **Cost Aspect of Maintenance:** Costs of machine breakdown; estimation of life cycle costs; Application of work measurement in maintenance; Manpower planning and training, Incentive payments for maintenance

3. **Planning of Maintenance Activities**: Evaluation of alternative maintenance policies breakdown, preventive and predictive maintenance; fault diagnosis and condition monitoring techniques; simulation of alternative practices; Development of preventive maintenance schedule; House keeping practices; total productive maintenance

4. **Maintenance Engineering:** Maintenance requirements of mechanical, electrical, process and service equipment; Safety aspect in maintenance; Aspect of lubrication; chemical control of corrosion; Computerized maintenance information systems 5. Reliability concept and definition, configuration of failure data, various terms used in failure data analysis in mathematical forms, component and system failures, ;uses of reliability concepts in design and maintenance of different system.

5. **Reliability and Availability of Engineering systems:** Quantitative estimation of reliability of parts; Reliability of parallel and series elements; Accuracy and confidence of reliability estimation; Statistical estimation of reliability indices; Machine failure pattern; Breakdown time distribution

6. **Reliability improvement** Reliability in design, reliability in engg, systems, systems with spares, reliability simulation, redundant and stand by systems, confidence levels, component improvement element, unit and standby redundancy optimization and reliability-cost trade off. Fault Tree Analysis: Introduction and importance, fault tree construction, reliability calculations from fault tree, tie set and cut set methods, event tree and numerical problems.

Text Books

1. Maintenance Engineering Handbook by Higgins LR
2. Principles of Planned Maintenance by Clifton, RH
3. Industrial Maintenance by Garg HP; S. Chand and Co
4. Maintenance Planning control by A Kelly (Indian ED)
5.Reliability Engineering by LS Srinath
6. Reliability Engg. Sinha S.k.Wiley EAstern.
7. Reliability Engg., Lewis, John Wiley.

3. MATERIAL MANAGEMENT

1**. Introduction** Meaning, definition, functions of materials management, Concept of integrated material management, Relationship of material management with other Organizational functions.

2. **Material Planning & Budgeting:** Need for material planning, Factors affecting material planning, Techniques of material planning; Material classification, codification and standardization; Material budgeting - meaning and need, techniques of material budgeting.

3. **Inventory Control**: Need and meaning of inventory, types of inventory, functions of inventory control, Inventory costs, Inventory control tool - ABC, VED, XYZ and FSN: Economic order Quantity and replenishment of stocks. Physical control of inventory: Fixed order, Two bin and Kardex systems - Material requirement planning (MRP-I) Spare parts control for maintenance purposes. Evaluation of inventory control performance. Concept of Just-in-Time(JIT). Use of computers for inventory control

4. **Purchasing:** Purchasing principles, procedures and systems, Functions of purchasing, Make-or-buy decision, Vendor development and vendor rating. Factors affecting purchase decisions, Legal aspects of purchasing, Documentation and procedure for import.

5.**Storage:** Functions and importance of store keeping, types of stores, store accounting and store verification, Legal aspects of store keeping, Management of surplus, scrap and obsolete items. Importance of material handling in store keeping, handling equipment.

Text Books

1. Materials Management by M.M Verma, S. Chand and Sons
2. Material Management - An Integrated Approach by gopal Krishnan and sundaresan:Prentice Hall
3. Purchasing and materials management by Dobbler and Burt; Tata McGraw Hill
4. Inventory control by Starr and Miller

4. NON CONVENTIONAL ENERGY SYSTEM

1.**Introduction:** Renewable and non-renewable energy sources, their availability and growth in India; energy consumption as a measure of Nation's development; strategy for meeting the future energy requirements

2. **Solar Energy:** Solar radiation - beam and diffuse radiation; earth sun angles, attenuation and measurement of solar radiation; Optical properties of materials and selective surfaces; Principles, general description and design procedures of flat Platte and concentrating collectors; Performance analysis of cylindrical and parabolic collectors; Solar energy storage systems - their types, characteristics and capacity; solar ponds. Applications of solar energy in water, space and process heating, solar refrigeration and air conditioning; water desalination and water pumping; solar thermal power generation; solar cells and batteries; economic analysis of solar systems

3. **Wind Energy:** Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of accodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations

4. **Direct energy conversion systems:**

i) Magnetic Hydrodynamic (MHD) Generator: gas conductivity and MHD equations; operating principle, types and working of different MHD systems – their relative merits; MHD materials and production of magnetic fields.

ii) Thermo-electric generators: Thermo-electric effects and materials; thermo-electric devices and types of thermo-electric generators; thermo-electric refrigeration.

iii) Thermionic generators: thermoionic emission and materials; working principle of thermionic convertors

iv) Fuel Cells: thermodynamic aspects; types, components and working of fuel cells.

v) Performance, applications and economic aspects of above mentioned direct energy conversions systems

5. **Miscellaneous Non-Conventional energy Systems:**

i) Bio-mass: Concept of bio-mass conversion, photo-synthesis and bio-gasification; Bio gas generators and plants - their types constructional features and functioning; digesters and their design; Fuel properties of bio gas and community bio gas plants

ii) Geothermal: Sources of geothermal energy - types, constructional features and associated prime movers.

iii) Tidal and wave energy: Basic principles and components of tidal and wave energy plants; single basin and double basin tidal power plants; conversion devices

Advantages/disadvantages and applications of above mentioned energy systems.

Text Books

1. Solar Energy : Fundamentals and Applications by H.P. Garg & Jai Prakash, Tata McGraw Hill
2. Soar Energy: Principles of Thermal Collection and Storage by SP Sukhatme, Tata McGraw Hill
3. Solar Engineering of Thermal Processes by Duffic and Beckman, John Wiley
4. Energy Conversion by Chang; Prentice Hall
5. Direct Energy Conversion by Soo; Prentice Hall
6. Fuel Cells by Bockris and Srinivasan; McGraw Hill
7. Magneto Hydrodynamics by Kuliovsky and Lyubimov, Addison

5. ENERGY CONSERVATION & MANAGEMENT

Need for energy conservation, its potentials, fiscal incentives, primary energy sources such as coal, gas, oil, nuclear fuel Optimum use of prime movers for power generation such as team turbines, gas turbines, diesel and gas engines, energy intensive industries i.e. iron and steel, aluminum, pulp and paper, textile and oil refineries and their energy usage pattern. Plant Good housekeeping measures in air conditioning boilers, combustion system, steam, furnaces and general awareness, Energy audit, methodology and analysis, Energy conservation case studies in air conditioning, boiler and burners Waste heat recovery systems i.e. recuperates economizers waste heat boilers, heat pipe heat exchangers regenerators etc. energy storage systems thermal storage, insulation, refractory, specialized processes such as Dielectric & micro wave heating, electronic beam welding, Fluidized bed technology, laser as a welding tool, Alternative sources of energy.

***Reference* Books**

1. Industrial Energy Conservation Handbook, D.A., Oxford Press, London
2. Energy Conservation Handbook, Utility Publication Ltd., Hyderabad
3. Richard Greene, Process Energy conservation (Chemical Engineering), McGraw-Hill Publication Co., New York.

6. HYDRO POWER PLANT ENGINEERING

Introduction: Energy sources for generation of electric power, Principles types of power plants-their special features and applications, Present status and future trends.

Hydro-Electric Power Plants: Classifications, Components and their general layout, Hydroelectric survey, rainfall run-off, hydrograph, flow duration curve, mass curve, storage capacity, Site selection.

Steam Power Plant: General Introduction, Developing trends, Essential features, Site Selection, Coal-its storage, preparation, handling, feeding and burning, Ash handling, dust collection, High pressure boilers.

Diesel and Gas Turbine Power Plants: Field of use, components, Plant layout, Comparison with stream power plants, Operation of combined steam and gas power plants.

Nuclear Power Plant: Nuclear fuels, nuclear energy, Main components of nuclear power plant, Nuclear reactors-types and applications, Radiation shielding, Radioactive waste disposal, Safety aspects.

Power Plant Economics: Load curves, terms and conditions, Effect of load on power plant design, methods to meet variable load, prediction of load, cost of electric energy, Selection of types of generation and generating equipment, Performance and operating characteristics of power plants, Load division among generators and prime movers, Tariff methods of electric energy.

Non-Conventional Power Generation: Geothermal power plants, Tidal power plants, Wind power plants, Solar power plants, Electricity from city refuge. Direct Energy Conversion Systems: Thermoelectric conversion system, Thermionic conversion system, Photo voltaic power system, Fuel Cells, Magneto-hydrodynamic system.

***Reference* Books:**

1. P.K.Nag, Plant Engineering, Tata McGraw Hill, New Delhi
2. Nagpal, Power Plant Engineering,Khanna Publishers, New Delhi
3. Arora, Domkundwar, Power Plant Engineering, Dhanpat Rai * Sons, New Delhi

7. HEAT EXCHANGER DESIGN

Introduction: Classification, types and applications of heat Exchangers, Heat Exchanger Design methodology, Selection of Heat Exchangers Single Phase Heat Exchangers: LMTD and NTU methods, Rating and sizing methods, design criteria, geometry, process parameters, pressure drops and applications

Two Phase Heat Exchangers: Types of Boiling, Boiling mechanisms, two phase flow
boiling pressure drop Condensation Mechanism, types of condensers and design procedures, Evaporators, Reboilers, Multiple effect evaporators, Design procedures, Liquid chillers, kettle, thermosyphen and forced circulation Reboilers, Augmented surface heat
Exchangers, Heat transfer coefficients, pressure drops, compact heat exchangers and air coolers, plate heat exchangers and plate fine heat exchangers Heat Pipe Heat Exchangers: Types and design procedure and applications Installation, Operation and Maintenance: Fouling factors, type of fouling and cleaning methods Mechanical Considerations: Codes and Standards, Mechanical design requirements and materials

Text Books

1. Saunders EAD, Heat Exchangers Selection Design and Construction Longman Scientific and Technical John Wiley and Sons Inc. New York
2. Kern D.Q. Process Heat Transfer International Edition Mc. Graw Hill Book Company Singapore
3. Holman J.P Heat Transfer 8th Edition Mc. Graw Hill Book Company Singapore
4. Gupta J.P Fundamentals of Heat Exchangers and Pressure Vessels Technology Hemisphere Publishing Corporation New York

8. INDUSTRY SAFETY ENVIRONMENT

Course Objectives:

1. Understand importance of safety at work
2. Apply ergonomics to safety
3. Analyze industrial hazards
4. Understand various safety measures and how it leads to increasing plant productivity.
5. Understand basics of environmental design
6 Compute heat load requirements of industrial buildings.
7. Understand various methods of solar architecture.
8. Compare the above with conventional methods
9. Understand various industrial wastes and their methods of treatment.
10. Understand ergonomics and its importance in system design.

Detailed Contents

1. Meaning & need for safety. Relationship of safety with plant design, equipment design and work environment. Industrial accidents, their nature, types and causes. Assessment of accident costs; prevention of accidents. Industrial hazards, Hazard identification techniques, Accident investigation, reporting and analysis.
2. Planning for safety: Definition, purpose, nature, scope and procedure. Range of planning, variety of plans. Policy formulation and implementation of safety policies. 3. Safety measures in a manufacturing organization, safety and economics, safety and productivity. Employees participation in safety. Safety standards and legislation
4. Meaning of environment and need for environmental control. factors in industry. Effect of temperature, Illumination, humidity noise and vibrations on human body and mind. Measurement and mitigation of physical and mental "fatigue" Basics of environment design for improved efficiency and accuracy at work.
5. Ventilation and heat Control Purpose of ventilation. Physiology of heat regulation. Thermal environment and its measurement. Thermal comfort. Indices of heat stress. Thermal limits for comfort, efficiency and freedom from health risk. Natural ventilation. Mechanical ventilation. Air conditioning Process ventilation. Control of heat exposures: control at source, insulation, and local exhaust ventilation. Control of radiant heat, dilution ventilation. Local relief.

6. Industrial Lighting: Purpose of lighting, benefits of good illumination. Phenomenon of lighting and safety. Lighting and the work. Sources and types of artificial lighting. Principles of good illumination. Recommended optimum standards of illumination. Design of lighting installation. Maintenance standards relating to lighting and colour. 7. Noise & Vibrations: Continuous and impulse noise. The effect of noise on man. Noise measurement and evaluation of noise. Noise isolation. Noise absorption techniques. Silencers vibrations: Effect, measurement and control measures.
8. Environment Standards: Introduction to ISO 14000; Environment standards for representative industries.

Text Books:

1. Ventilation by Joselin, Edward Arnold
2. Noise Reduction by Beranek, Mcgraw Hill
3. Modern Safety and health Technology by DC Reamer; R. Wiley
4. Industrial Accident Prevention by Heinrich, HW; McGraw Hill
5. The process of Hazard Control by Firenze, RJ; Kendale

8.3 ELECTIVE-II

1. INDUSTRIAL AUTOMATION & ROBOTICS

1. **Introduction :** Concept and scope of automation: Socio economic consideration: Low cost automation.
2. **Fluid Power Control** : Fluid power control elements and standard graphical symbols. Construction and performance of fluid power generators; Hydraulic and pneumatic cylinders - construction, design and mounting; Hydraulic and pneumatic valves for pressure, flow and direction control: Servo valves and simple servo systems with mechanical feedback, governing differential equation and its solution for step position input; Basic hydraulic and pneumatic circuits.
3. **Pneumatic Logic Circuits** : Design of pneumatic logic circuits for a given time displacement diagram or sequence of operations.
4. **Fluidics** : Boolean algebra; Truth tables; Conda effect; Fluidic elements – their construction working and performance characteristics: Elementary fluidic circuits.
5. **Transfer Devices and Feeders :** their Classification : Construction details and application of transfer devices and feeders(vibratory bowl feeder, reciprocating tube and centrifugal hopper feeder).
6. **Electrical and Electronic Controls :** Introduction to electrical and electronic controls such as electromagnetic controllers - transducers and sensors, microprocessors, programmable logic controllers (PLC); Integration of mechanical systems with electrical, electronic and computer systems.
7. **Robotics**: Introduction, classification based on geometry, devices, control and path movement, End effectors - types and applications: Sensors - types and applications. Concept of Robotic/Machine vision, Teach pendent.
8. Industrial Applications of Robots for material transfer, machine loading / unloading, welding, assembly and spray painting operations.

Text Books

1. Fluid Power with applications by Anthony Esposito
2. Pneumatic Control by SR Majumdar
3. Robotics and Flexible Automation by SR Deb

2. TOOL DESIGN

1.**Process Planning:**

Product Engineering, Process Engineering, Definition of Process Planning, Contents of Process Plan, Process Operations, Steps of Process Planning, Process Planning Sheet, Planning and Tooling for Low Cost Planning.

2.Jigs & Fixture

Principles of jig and fixture design, Principle of degrees of freedoms, methods of locations and clamping, Various devices for location and clamping, indexing devices, Hydraulic and pneumatic actuation of clamping devices, jig bushes, use of standard parts of jig design, type of drilling jigs, milling fixtures, lathe fixture, grinding fixtures and their classification.

3.Die Design

Components of die design, design of die blocks, punches and strippers, methods of holding punches, sketches of stock stops, Design procedure for progressive dies, compound dies and combination dies for press tool operation forging die design for drop and machine forging parts.

4.**Tool Layout for Turrets**

Characteristics of Turret lathes. Differences between capstan and turret lathes, methods of holding jobs on the Turret lathe. Universal chucking equipment, universal bar equipment, operation sheet and tool layout.

5.**Tool Layout for Automatics**

Classification of Automatics; Turret type automatic, tool layout procedure, time required for each operation, operation sheet, tool layout, cam layout.

6.Tooling Costs

Estimating cost of a product, estimating costs of tools, Economics of tooling, Break even point analysis, minimum cost analysis.

7.**Gauges**

Limits and fits, Plain Gauges, types of Gauges, fundamentals of Gauge Design, Gauge makers tolerance, allowance for wear, Practical application of Taylor's principles of limit gauging, care of Gauges, Limitation of Limit Gauging.

8.**Surface Finish**

Elements of surface finish, Factors affecting surface finish, Effect of surface quality on Functional properties of machine parts, Evaluation of surface finish, Indian Standards on surface finish. Measurement of surface finish, Relationship of surface finish to the production methods. Finishing operations like honing, lapping, buffing super finishing etc.

Text Books :

1. Cole: Tool Design
2. Donaldson: Tool Design
3. ASTEM: Fundamentals of Tool Design
4. P.C.Sharma: A Textbook of Production Engg., S.Chand Publication,N.Delhi

3. PRODUCT DESIGN & DEVLOPMENT

VISUAL DESIGN:
Basic elements and concept of visual design-line color, Balance proportion, Size shape mass, unity and variety, Special relationships and composition in two and three dimensions.
FORM & COLOR
Elementary forms their characteristics and significance in design. Form transition, Form in relation to ergonomics, material and manufacturing process, color as an element of design, color clarification dynamics, interrelation of colors, colors and traditions; Psychological use of color form and material.
PRODUCT GRAPHICS:
Meaning and objectives of product graphics. Basic principles of graphic design, Visual communication aspects of product graphics, Graphics of displays and control panels,
PRODUCT DETALING:
Standard fastening and joining details in different materials; Temporary and permanent joints: Detailing for plastic products, Detailing for fabricated products in sheet metal.
PRODUCTS DEVELOPMENT:
Definition and objective, Role of designer in product development. Manufacturing and economic aspects of product development, Product promotions, product developments

Text Books:
1. Mayall W.H., “Industrial Design for Engineers” London Liifee Books Ltd. 1967
2. Dale Huchingson R “New Horizons for Human Factors in Design ” McGraw Hill Company 19811.Indistrial Design-Mayall
3. Engineering Design- Svensson.
4,. Engineering Design-Matousek
5. Mccormick K.J. (Ed) “Human Factor Engineering ” 4th edition McGraw Hill Book Company Ltd. USA 1992

4. POWER PLANT ENGINEERING

Introduction: Energy sources for generation of electric power, Principles types of power plants-their special features and applications, Present status and future trends.

Hydro-Electric Power Plants: Classifications, Components and their general layout, Hydroelectric survey, rainfall run-off, hydrograph, flow duration curve, mass curve, storage capacity, Site selection.

Steam Power Plant: General Introduction, Developing trends, Essential features, Site Selection, Coal-its storage, preparation, handling, feeding and burning, Ash handling, dust collection, High pressure boilers.

Diesel and Gas Turbine Power Plants: Field of use, components, Plant layout, Comparison with stream power plants, Operation of combined steam and gas power plants.

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2. Nagpal, Power Plant Engineering,Khanna Publishers, New Delhi
3. Arora, Domkundwar, Power Plant Engineering, Dhanpat Rai * Sons, New Delhi

5. HYDRAULICS & PNEUMATICS

1. **Introduction to fluid Power**- Classification, general features, applications in various fields of engineering, various hydraulic and pneumatic ISO/JIC Symbols, transmission of power at static and dynamic states, advantages and disadvantages.
2. **Types of hydraulic** fluids and their properties, selection of fluid, effect of temperature on fluids.
3. **Hydraulic system elements**- Classification, types a seals sealing material, pipes, hoses, compatibility of seal with fluid, sources of contamination and its control elements, strainer, filter, heat-exchanger, b) Pumps- types, classification, principle of working, power calculations, efficiency, characteristics curves, selection of pumps from vane, radial, piston, axial, screw, ball pump etc for various applications.
4. **Control of fluid Power elements:-**

a) Requirements of Pressure control, direction control, flow control valves

b) Principle of pressure control valves, direction control valves, pilot operated relief, pressure reducing, quick exhaust, sequence valves, flow control valves and their types, Meter-in and Meter-out circuit and flow through circuit.

c) Types of direction Control valves- two way two position, four way, two position, four way three position, open center, close center, tandem center, manual operated, solenoid, pilot operated direction control valves, check valves.

d) Actuators- linear and rotary, hydraulic motors, types of hydraulic cylinders and their mountings.

e) Calculation of piston velocity, thrust under static and dynamic operation and application, considerations of friction and inertia loads.

5. **Hydraulic circuit** and applications study of accumulator, intensifier, jack, power pack etc linear and re-generative circuits with accumulator and intensifier, various hydraulic circuits, components, working and applications.
6. **Hydraulic servo**- system for rotary and linear motion.
7. **Maintenance and safety of hydraulic system**.
8. **Introduction:** Application of pneumatics, Physical Principles, basic requirement of pneumatic system, comparison with hydraulic system
9. **Elements of Pneumatic System:** Air compressor- Types, selection criteria, capacity control, piping layout, fitting and connectors, Pneumatic controls, Direction control valves (two way, three way, four way), check valves, flow control valves, pressure control valves, speed regulators, quick exhaust valves, solenoid, pilot operated valves, Pneumatic actuators, Rotary & reciprocating cylinders – types and their mountings, Air motor – types, Comparison with hydraulic and electric motor.
10. **Serving of compressed air** – types of filters, regulators, lubricators (FRL unit), mufflers, dryers.
11. **Pneumatic circuits**- basic pneumatic circuit, impulse operation, speed control, pneumatic motor circuit, sequencing of motion, time delay circuit & their applications.
12. Pneumatic servo system for linear & rotary motion.
13. Maintenance, troubleshooting and safety of hydro pneumatic systems.
14. **Introduction to fluidics** – study of simple logic gates, turbulence, amplifiers. Pneumatic sensors, applications.

8.4 OPERATION RESEARCH

1. **Introduction** : Origin of OR and its role in solving industrial problems : General approach for solving OR problems. Classification of mathematical models : various decision making Environments.
2. **Deterministic Models :** Formulation of deterministic linear mathematical models :
Graphical and simplex techniques for solution of linear programming problems, Big Mmethod and two phase method, Introduction to duality theory and sensitivity analysis : transportation, assignment and sequencing models; Introduction to goal programming; Solution techniques of linear goal programming problems.
3. **Probabilistic Models** : Decision making under uncertainty : Maximum and minimum models; Introduction to decision tree. Game theory : Solution of simple two person zero-sum games :Examples of simple competitive situation.
4. **Simulation:** Concept general approach and application. Use of Monte-Carlo simulation technique to queuing and inventory problems. 5. Dynamic Programming: Introduction to deterministic and probabilistic dynamic programming. Solution of simple problems.
6. **Queuing theory:** Types of queuing situation : Queuing models with Poisson's input and exponential service, their application to simple situations.
7. **Replacement Models :** Replacement of items that deteriorate, Replacement of items whose maintenance and repair costs increase with time, replacement of items that fail suddenly; replacement of items whose maintenance costs increase with time and value of money also changes, individual replacement policy, group replacement policy.
8. **Inventory models :** Classification of inventory control models : Inventory models with deterministic demand, inventory models with probabilistic demand, inventory models with price breaks.
9. **Network models** : Shortest route and traveling sales - man problems, PERT & CPM introduction, analysis of time bound project situations, construction of net works, identification of critical path, slack and float, crashing of network for cost reduction, resource leveling and smoothening.

Text Books:

1. Principles of Operations Research HM Wagner, Prentice Hall.
2. Operations Research PK Gupta and DS Hira, S. Chand & Co.
3. Introduction to Operation Research Taha
4. Introduction to Operation Research F.S. Hiller and G.I. Libermann, Holden Ray.

8.5 MECHANICAL VIBRATIONS

1.**Introduction** ; Basic concepts, Methods of vibration analysis, Types of vibration, Periodic &Harmonic vibrations . undamped free vibrations, damped free vibrations and damped force vibrations of single degree of freedom system,vibration isolation transmissibility.vibration measuring instruments.

2. **Two degrees of Freedom systems:**

a) Principal modes of vibrations, natural frequencies, amplitude ratio, forced harmonic vibration .combined rectilinear & angular modes.

b) Application; Vibration absorber - principle, centrifugal pendulum vibration absorber, torsional vibration damper, unturned viscous damper, dry friction dampers, torsional vibration of two rotor systems.

3.

a) Multi-degree of freedom systems: undamped free vibrations, influence coefficients,generalised coordinates,orthogonality principal,matrix alteration methods,: Rayleigh and Dunkerley, Holzer's , stodola method,Eigen values & eigen vector

b) continuous systems: Vibration of a string, longitudinal vibrations of bars, Euler's equation of motion for beam vibration, natural frequencies for various end conditions, torsional vibration of circular shafts

Text Books:

1. Mechanical Vibrations by GK Grover, Hem chand and Bros, Roorkee
2. Mechancial Vibrations by KK Purjara, Dhanpat Rai and Sons, Delhi
3. Mechanical Vibrations by V.P.Singh,.

8.6 AUTOMOBILE ENGINEERING LAB

List of Experiments

1. Valve refacing and valve seat grinding and checking for leakage of valves
2. Trouble shooting in cooling system of an automotive vehicle
3. Trouble shooting in the ignition system, setting of contact breaker points and spark plug gap
4. Demonstration of sterring system and measurement of steering geometry angles and their impact on vehicle performance.
5. Trouble shooting in braking system with specific reference to master cylinder, brake shoes, overhauling of system and the adjusting of the system and its testing.
6. Fault diagnosis in transmission system including clutches, gear box assembly and differential.
7. Replacing of ring and studying the method of replacing piston after repair.

8.7 PROJECT

Duration

Full Sixth or Seventh Semester is meant for Industrial Training

Purpose

To expose engineering students to technology development at work places and appraise them regarding shop-floor problems ¨ To provide practical experience in solving open ended problems in real work setting so as to cause transfer of college based knowledge and skills to solve practical problems and thereby develop confidence in the students in the analysis, synthesis and evaluation of practical problems leading to creative thinking.

Programme

During this work bench involvement, students will be given 3-4 practical problems. The problems assigned should be of mutual interest to the students and the industry. The problem may belong to 3 or 4 different functional areas. To illustrate, following are some of the suggestions: ¨

Design of a prototype

¨ Programming of CNC machines

¨ Calibration and testing of instruments

¨ Productivity Improvement Studies

¨ Pollution control related problems

¨ Capacity Planning and Capital Budgeting

¨ Safety Management

¨ Optimum utilization of resources

¨ Conflict Management

Methodology

¨ The industrial organizations where students are to be sent for problem solving project-oriented work bench involvement may be selected well in advance

¨ The faculty of the department is expected to visit the selected industries and identify suitable problems to be handled by students.

¨ It will be desirable that problems be matched with the interests of students.

¨ It is recommended that a group of 5-6 students be guided by one faculty member during this period.

The evaluation of students is proposed to be done by internal faculty with active involvement of industrial personnel. The evaluation may be based on following criteria:

¨ Punctuality and Attendance ¨ Interpersonal relations

¨ Sense of Responsibility

- Clarity of concepts, principles and procedures

¨ Self expression/communication skills

¨ Report Writing Skills

¨ Creativity/conceiving new and unusual ideas

¨ Problem-solving skills

9. SUGGESTIONS FOR EFFECTIVE IMPLEMENTATION OF CURRICULUM

Curricula for degree programmes in engineering and technology have been designed by SSU Palampur faculty with close cooperation of SSE Badhani and Amritsar They have understood the systematic approach of curriculum development and implementation. While designing the curriculum they have taken in to account employment scenario, equivalence with PTU curriculum and experience of implementing existing curriculum.

Some of the suggestions for effective implementation of curriculum are:

-1.Vision and mission of institute, Philosophy objective and outcome of curriculum of programmes should be understood by all teachers and students. These should be displayed in the Department so that expectation of all stake holders are clear to everyone.

2.Principal with Head of Departments should analyze the curriculum to find out the requirement of resources for its implementation and prepare an action plan for their availability in time. Institute should network with other organizations for sharing resources and adopt innovative approaches for managing whole courses.

3.HOD's and teachers are managers of whole programmes and subject teaching respectively. Their success in achieving objectives depends on preparing academic plan and its judicious execution.

4.Teachers should prepare rationale and objective of their respective subjects, structure of content, method and media and table of specification for evaluation. This should be given to student so that they are aware of the outcome of the course.

5.Set up a group of teachers and final year students for sharing experiences of curriculum implementation and suggest further improvement.

6.Teachers are required to plan as follows for carrying out teaching learning process effectively: -

(a) Prepare profile of students for knowing their background and strengths so as to facilitate them in fulfilling their dreams of jobs and life.

(b) Analyze programme and develop teaching plan.

(c) Plan for guided self study exercises for student and available learning resources like journals, web site, educational video programming etc in addition to visit to industries and organizing industrial training, arranging expert lecture by alumni and experts from industry/ field.

(d) The co-curricular activities like organizing different camp, social gathering study tour, hobby club etc may be used to develop generic skills like communication skills, task

Management, problems solving, managing self, stress Management, Time Management and collaborating with others etc.

1. A project bank may be developed by the concerned department of the university in consultation with industry, research and other relevant field organizations.

2. Student may be given practical assignment and project to develop practical skills. This will help them in developing creativity and confidence for their gainful employment, (wage and self).

3. (a). Teachers and students should be aware of objectives and outcomes of whole programme and the role played by each subjects in achieving them as part of the curriculum.

   (b). Identification of project and their details should be prepared by all teachers in consultation with students at the beginning of the year. The projects should relate to state of art technology and require use of theoretical and advance planning practical knowledge.

   ©. Self learning and learning beyond syllabus should be encouraged by including optional subjects with scope of learning.

   (d). Department should develop a feedback Mechnism for teaching performance and a reward system for doing excellence work.

   (e) Academic calendar should include remedial classes and additional make up test to help academically weaker students. Students involved in mentoring junior students should be should be rewarded, who are actively doing mentoring.

10. APPENDIX

A. STUDENT CENTERED ACTIVITIES

Student centered activity play an imported role in the development of students of independent learning and self confident among students. Consulting library and visit to market or industry for gathering search information. This information will be presented by students during seminars. Expert lectures by eminent person from technical education, industry, culture areas; and alumni of the institute will also be arranged. Students will also undertake activities like mentoring students poor in academics, community service in respect of technology transfer entrepreneurship development and environmental awareness for fulfilling the outcome of programme.

B. MAJOR PROJECT WORK

(Industry/field oriented-practice based)

As far as possible students shall be assigned live project problem with a view to:

1 Develop understanding regarding the size and scale of operation and nature of field work in which Students are going to plan their role after completing the programme of study.

2 Develop understanding of subject based knowledge given in the classroom in the control of its application at work place.

3 Provide first hand experience to develop confidence amongst the students to enable them to use and apply classroom based knowledge skills to solve practical problem of the world of work.

4 Develop social skills and abilities like interpersonal skills, communication skills, attitude and values.

For the fulfillment of above objective, SSU University will establish close linkages with 20-25 relevant organizations and provide such experience to students. It is necessary that each organization is visited well in advance by respective teachers and projects activities to be performed by students are well defined. Efforts should be made to identify actual field problems to be given as project work to the students. Project selected should be challenging. Such chosen projects assignment should be entrusted to students which are of professional value to industrial/field organization. Each teacher would supervise and guide 10-15 students.

. The placement of students for such a practical cum project work should match with the competency profile and interest of students. Students are to be assessed both by industry and engineering college faculty.

The suggested performance criterion is given below:

a)	Punctuality and regularity	10
b)	Initiative in learning/ working at site	10
c)	Level/processing of practical skills acquired	10
d)	Sense of responsibility	10
e)	Self expression/ communication skills	10
f)	Interpersonal skills	10
g)	Reports writing skills	20
h)	Viva voce	20

Note :The above is a guideline only. Ssu palampur may devise its own criteria in consultation with industry.

C. ENTREPRENEURSHIP DEVELOPMENT CAMP AND SETTING SELF BUSINESS CLUB IN INSTITUTE

A large population of degree holders has to think of setting up their own enterprises or businesses due to lack of opportunities in organized sector. They have to be motivated and trained to search for new opportunities and avail these for becoming an entrepreneur. For this they must be acquainted with entrepreneurship development, scope of setting up self enterprise, existing business opportunities, financial support available and various aspects of managing business. In this context an entrepreneurship awareness camp is suggested. During the camp, experts from various organizations such as banks, financial corporations, service institutes etc. Should be invited to deliver expert lectures. Successful entrepreneurs should also be invited to interact with the students. Students may be encouraged to read papers or give seminar during the camp, on entrepreneurship development related topics.

1. The camp is to be organized for two to three days at a stretch during fifth semester. Lectures will be delivered on the following broad topics. There will be no examination for this subject.

- Who is an entrepreneur?
- Need for entrepreneurship, entrepreneurial career and self employment.
- Scenario of development of small scale industries/service organization in India and other countries.
- Entrepreneurial history in India, Indian values and entrepreneurship.
- Consideration for product/business selection.
- Opportunities for business, seminar and industrial ventures.
- Learning from Indian experiences in entrepreneurship (Interaction with successful entrepreneurs).
- Managerial aspects of small business.
- Legal aspects of small business.

2. Assistance from District Industries Centers, Commercial banks, and state Financial Corporation's Small industries service Institutes, Research and developments laboratories and other financial and Development Corporation.

3.In order to arrange successful entrepreneurship awareness camp, a group of interested students for setting up their self business may be identified and given responsibility of undertaking the above .A follow up mechanisms should be evolved at the institute in order to enable student to set up and manage their enterprise. This group should regularly meet after a month to see the progress of their project and get inputs from mentors.

D. ECOLOGY AND ENVIRONMENTAL AWARENESS CAMP

A degree holder must have knowledge of different types of pollution caused due to public, Industries and construction activities. So that he may help in balancing the eco system and controlling pollution by pollution control measures. He should also be aware of environmental laws related to the control of pollution.

This can be done by organizing a camp at a stretch for 3-4 days. Lectures will be delivered on following broad topics. There will be no examination for this subject. Students interested to contribute in improving ecology and environment of the institute or community through various projects, may be allotted marks out of 20 (a part of final year project)

1. Sources of pollution natural and manmade, their effects on living and non living organisms.
2. Solid waste management; classification of refuse material, types, sources and properties of solid wastes, abatement methods, methods of vermin composting.
3. Pollution of air-causes and effects of man, animal, vegetation and non living organisms.
4. Pollution of water causes, effects of domestic waste and industrial effluent on living and non-living organisms.
5. Legislation to control pollution and protect environment.
6. Recycling for taking advantage of waste and reducing pollution.

It is suggested that, at the institution level, a voluntary group be formed for taking care of ecological balance by undertaking waste management projects- which would result in additional revenue to the institute, besides presenting a more friendly environment.

E. INDUSTRIAL TRAINING

Industrial Training shall be accomplished through attachment with an industry/ service sector organization. Teachers in consultation with industry/ service sector will identify the problem/ project for students. A Group of students placed in city will be monitored by the faculty or expert appointed for the purpose. During the 6 month training, the students will be required to maintain a training diary which will be required to be duly authenticated by his supervisor in the industry.