



CHRIST
UNIVERSITY
BANGALORE, INDIA

Declared as Deemed to be University under Section 3 of UGC Act 1956

FACULTY OF ENGINEERING

Kengeri Campus, Kanminike, Kumbalagodu, Bangalore – 560060

COURSE STRUCTURE AND SYLLABUS

B.Tech (Mechanical)

Modified for the years

2011-12, 2012-13, 2013-14

and approved for the year

2014-15

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ABOUT US

01.INTRODUCTION

Christ University was formerly Christ College (Autonomous) affiliated to Bangalore University. Established in July 1969, Christ College became the most preferred educational institution in the city of Bangalore within the first three decades. From 1990 onwards it scaled from heights to heights. By the introduction of innovative and modern curriculum, insistence on academic discipline, imparting of Holistic Education and with the help of the creative and dedicated staff, Christ College has been continually rated among the top 10 educational institutions of the country. It has the rare distinction to be the first institution in Karnataka to be accredited by National Assessment and Accreditation Council (NAAC) UGC for quality education. On 7 October 2004, UGC has conferred Autonomy to Christ College (No.F.13-/2004).

On May 20, 2005, it became the first College in South India to be reaccredited with A+ by NAAC. UGC has identified it as an Institution with Potential for Excellence in June 2006. July 22, 2008 is the most glorious day in the history of the institution. Under Section 3 of the UGC Act, 1956, Ministry of Human Resources Development of the Union Government of India, vide Notification No. F. 9-34/2007-U.3 (A), has declared it a Deemed to be University, in the name and style of Christ University

Christ University**VISION****"EXCELLENCE AND SERVICE"**

- ❖ Christ University, a premier educational institution, is an academic fraternity of individuals dedicated to the motto of excellence and service. We strive to reach out to the star of perfection through an earnest academic pursuit for excellence and our efforts blossom into 'service' through our creative and empathetic involvement in the society to transform it.
- ❖ Education prepares one to face the challenges of life by bringing out the best in him/her. If this is well accepted, education should be relevant to the needs of the time and address the problems of the day. Being inspired by Blessed Kuriakose Elias Chavara, the founder of Carmelites of Mary Immaculate and the pioneer in innovative education, Christ University was proactive to define and redefine its mission and strategies reading the signs of the time.

MISSION

"Christ University is a nurturing ground for an individuals holistic development to make effective contribution to the society in a dynamic environment."

Department of Mechanical Engineering**VISION**

**TO IMPART EXCELLENT TECHNICAL EDUCATION IN MECHANICAL ENGINEERING PROGRAMS
THAT WILL ENABLE THE STUDENTS TO SERVE THE SOCIETY**

MISSION

“To develop Mechanical Engineering students into responsible and passionate professionals, who are able to actively pursue and solve real life problems in a dynamic environment through prudent, lean and creative usage of resources”

CORE VALUES

The values which guide us at Christ University are:

- **Faith in God**
- **Moral Uprightness**
- **Love of Fellow Beings**
- **Social Responsibility**
- **Pursuit of Excellence**

02. COURSE OFFERED

• Undergraduate Programmes (B. Tech in)

B. Tech in-

- Civil Engineering(CIVIL)
- Computer Science and Engineering (CSE)
- Electronics and Communication Engineering (ECE)
- Electrical and Electronics Engineering (EEE)
- Information Technology (IT)
- Mechanical Engineering (MECH)
- Automobile Engineering (AE)

• Int. BTech with MBA

- Int. BTech(CIVIL) with MBA (Finance/HR/Marketing/Lean Operations & Systems)
- Int. BTech(CSE) with MBA (Finance/HR/Marketing/Lean Operations & Systems)
- Int. BTech(ECE) with MBA (Finance/HR/Marketing/Lean Operations & Systems)
- Int. BTech(EEE) with MBA (Finance/HR/Marketing/Lean Operations & Systems)
- Int. BTech(IT) with MBA (Finance/HR/Marketing/Lean Operations & Systems)
- Int. BTech(MECH) with MBA (Finance/HR/Marketing/Lean Operations & Systems)

• Int. BTech with M. Tech (5 Years Program)

- Int. BTech(Civil) with MTech (Structural Engineering)
- Int. BTech(CSE) with MTech (CSE)
- Int. BTech(ECE) with MTech (Communication Systems)
- Int. BTech(EEE) with MTech (Power Systems)
- Int. BTech(IT) with MTech (IT)
- Int. BTech(Mech) with MTech (Machine Design)

• Postgraduate Programmes (M. Tech) (2 Years Program)

- Master of Technology in Computer Science & Engg.
- Master of Technology in Communication Systems

• Doctoral Programmes (Ph.D.) (Doctor of Philosophy)

- Doctor of Philosophy (Ph.D.) in Computer Science and Engineering
- Doctor of Philosophy (Ph.D.) in Electronics and Communication Engg.
- Doctor of Philosophy (Ph.D.) in Mechanical Engineering

03. ELIGIBILITY CRITERIA

❖ **For Undergraduate Programmes and Int. B Tech with MBA & Int. B. Tech with M. Tech:**

A pass in PUC (10+2) or equivalent with 50% marks in aggregate with Mathematics, Physics and Chemistry is the minimum eligibility for admission

Lateral Entry:

Candidates who have successfully completed 3 year diploma in Engineering are eligible to apply for lateral entry into BTech courses

Candidates will be admitted to second year of the programme only after appearing the Christ University selection process for engineering programmes.

❖ **For Postgraduate Programmes:**

- For Master of Technology in Computer Science & Engineering
 - A Pass in B.Tech/B.E or M.Sc with 55% aggregate.
- For Master of Technology in Communication Systems
 - A Pass in B.Tech/B.E or **M.Sc in Electronics** and VLSI Design with 55% aggregate.
- For Master of Technology in Civil Engineering
 - A Pass in BE/BTech or **M.Sc in Civil** and VLSI Design with 55% aggregate.
- For Master of Technology in Mechanical Engineering
 - A Pass in BE/BTech.

❖ **For Doctoral Programmes (Ph.D.):**

- A pass with 55% marks in post graduation and equivalent in the relevant subject from any recognized university.
- A research proposal (Maximum 1500 words) has to be submitted along with the application.

04. SELECTION PROCESS

- 1) Candidates can process the admission based on the Undergraduate Entrance Test and Ranking by COMEDK. **OR**
- 2) Christ University Selection Process as given below:

Process	Particulars	Date	Venue/Centre
Entrance Test	Christ University Entrance test for each candidate	As per the E-Admit Card	As per the E- Admit Card
Personal Interview	Personal interview for 15 minutes for each candidate by an expert panel	As per the E-Admit Card	As per the E- Admit Card
Academic Performance	Assessment of past performance in Class 10, Class 11/12 during the Personal Interview	As per the E-Admit Card	As per the E- Admit Card

05. ADMISSION PROCESS

Candidates will be intimated about the Selection status (Selected/Wait Listed/Not Selected) through the University Notice Board/on the “Application Status” link on University website. The Selection results will be declared within 24 Hours of Personal Interview sessions.

The selected candidates must process admission at **Office of Admissions, Central Block, Christ University within 3 working days of declaration of Selection Process results/as per the stipulated date and time mentioned by Office of Admissions.**

Selected candidates should collect the Fee Challan from the Office of Admissions and remit the Annual fee at the South Indian Bank, Christ University Branch. The **Offer of Admission** will stand cancelled, if failing to remit the fee within the stipulated date and time.

Admission will not be processed without the presence of the candidate and the mandatory original documents mentioned below;

1. The Offer of Admission Card (E-Admission Card/Mail)
2. Class 10 Marks Statement
3. Class 11 Marks Statement, if Candidate is pursuing class 12 and appearing for final examination during March-April
4. Class 12 Marks Statement, if candidate has appeared and passed the Class 12

examination

The University ID card is a smart card, which is both an ID card as well as a South Indian Bank ATM card with a chip containing the student personal details. All transactions within the University campus after commencement of classes, including fees payment will be processed only through this card. It is also an access card for Library and other restricted places. Candidates are advised to collect the South Indian Bank account opening form along with fees challan and process it at the Bank branch within the University premises.

Candidates who fall under International student category (ISC), If selected, should register with the Foreigner Regional Registration Officer (FRRO/FRO) of the Local Police in Bangalore, India within 14 working days from the date of admission or arriving in Bangalore. All International student category (ISC) candidates if studied in India should obtain an NOC from the previous qualifying institution.

06. GENERAL RULES

- There is a grading scheme for each paper and for all the courses.
- All marks will indicate the marks, percentage obtained, grade and grade point average.
- The grade point average will be calculated as follows: for each subject, multiply the grade point with the number of credits; divide the sum of product by the total number of credits.
- The CGPA [Cumulative GPA] is calculated by adding the total number of earned points [GP x Cr] for all semesters and dividing by the total number of credit hours for all semesters.

$$\text{GPA} = \frac{\sum[\text{GPA} \times \text{Cr}]}{\sum \text{Cr}}$$

07. Grading scheme for Each Paper: Undergraduate Courses

Percentage	Grade	Grade Point	Interpretation	Class
80 and above	A	4.0	Outstanding	First Class with Distinction
73-79	A-	3.67	Excellent	First Class
66-72	B+	3.33	Very Good	
60-65	B	3.0	Good	
55-59	B-	2.67	Average	Second Class
50-54	C+	2.33	Satisfactory	
45-49	C	2.00	Pass	Pass Class
40-44	D	1.0	Pass	
39 and below	F	0	Fails	Fail

08. Grading scheme for Each Paper: Postgraduate Courses

Percentage	Grade	Grade Point	Interpretation	Class
80 and above	A+	4.0	Excellent	First Class with Distinction
70-79	A	3.5	Very Good	
65-69	B+	3.0	Good	First Class
60-64	B	2.5	Above Average	
55-59	C+	2.0	Average	Second Class
50-54	C	1.5	Satisfactory	
40-49	C-	1.0	Exempted if aggregate is more than 50%	Pass Class
39 and below	F	0	Fails	Fail

DETAILS OF CIA (Continuous Internal Assessment):

Assessment is based on the performance of the student throughout the semester.

Assessment of each paper

- Continuous Internal Assessment (CIA) for Theory papers: 50% (50 marks out of 100 marks)
- End Semester Examination(ESE) : 50% (50 marks out of 100 marks)

Components of the CIA

CIA I : Mid Semester Examination (Theory)	: 25 marks
CIA II : Assignments	: 10 marks
CIA III: Quizzes/Seminar/Case Studies/Project Work	: 10 marks
Attendance	: 05 marks
Total	: 50 marks

For subjects having practical as part of the subject

End semester practical examination	: 25 marks
Records	: 05 marks
Mid semester examination	: 10 marks
Class work	: 10 marks
Total	: 50 marks

Mid semester practical examination will be conducted during regular practical hour with prior intimation to all candidates. End semester practical examination will have two examiners an internal and external examiner.

09. COURSE OVERVIEW

The Mechanical Engineering Department has well established facilities for carrying out the activities of basic mechanical engineering. It is equipped to meet the present day technological advances and to meet the industrial requirements matching with the global standards. The department has the state of the art laboratories to meet the demand for practical knowledge by the present day industrial applications.

One of the oldest, largest and diversified of all engineering disciplines is mechanical engineering. Rated as one of the most "evergreen" branches, students of mechanical engineering can look forward to an exciting and robust study in the field of Thermal, Design, Materials and Manufacturing Engineering. A Holistic blend of both theory and practicals ensure that students are ready to face the challenges of the industrial world.

10. COURSE OBJECTIVE

The goal of our program is to prepare our graduates for successful professional practice and advanced studies by providing a broad education in mechanical engineering and by offering the opportunity to deepen their technical understanding in a particular concentration area of related technical electives. Following are the course objectives.

1. Join a technically sophisticated workforce as successful, practicing engineers in a wide range of mechanical engineering fields.
2. Continuously improve and expand their technical and professional skills through formal means as well as through informal self-study.
3. Pursue advanced degrees in engineering, business, or other professional fields.
4. Advance themselves professionally and personally by accepting responsibilities and pursuing leadership roles.

11. TEACHING PEDAGOGY

Our teaching methodology ensures that students are being exposed to a holistic education experience in an active and dynamic learning environment, giving them the opportunity to identify and realize their potential, and to achieve excellence. In order to realize the objectives, a methodology based on the combination of the following will be adopted:

1. Team/Class room teaching.
2. PowerPoint presentations and handouts.
3. Simulated situations and role-plays.
4. Video films on actual situations.
5. Assignments.
6. Case Studies.
7. Exercises are solved hands on.
8. Seminars
9. Industry / Field visits.
- 10.** Information and Communication Technology.
11. Project work.
12. Learning Management System.

12. ASSESSMENT RULES

❖ Assessment of Project Work

○ Continuous Internal Assessment:100 Marks

- Presentation assessed by Panel Members
- Assessment by the guide

○ End Semester Examination:100 Marks

- Viva Voce
- Demonstration
- Project Report

❖ Assessment of Comprehension

❖ Assessment of Seminar

- Continuous Internal Assessment:50 Marks
- **Seminar on topics on emerging and thrust areas –minimum two seminars**
- **Student's presentation on topics studied during their course**
- **Topics to be approved by the department**
- **Presentation assessed by Panel Members of Department**

13. BRIEF OF PHYSICS AND CHEMISTRY CYCLE:

- B. Tech first year is followed by two semesters and each semester is divided into two Cycles i.e. Physics Cycle and Chemistry Cycle.
- Accordingly, All First year students are also divided among both Physics Cycle and Chemistry Cycle.
- The students in Physics Cycle will be moved to Chemistry Cycle and the Chemistry Cycle students will be moved to Physics Cycle respectively in next Semester (i.e. Second semester).

14. QUESTION PAPER PATTERN:**End Semester Examination (ESE) :****Theory Papers:**

The ESE is conducted for 100 marks of 3 hours duration.

The syllabus for the theory papers is divided into FIVE units and each unit carries equal weightage in terms of marks distribution.

Question paper pattern is as follows.

Two full questions with either or choice will be drawn from each unit. Each question carries 20 marks. There could be a maximum of three sub divisions in a question. The emphasis on the questions is broadly based on the following criteria: 50 % - To test the objectiveness of the concept
30 % - To test the analytical skill of the concept
20 % - To test the application skill of the concept

Laboratory / Practical Papers:

- The ESE is conducted for 50 marks of 3 hours duration.
- Writing, Execution and Viva - voce will carry weightage of 20, 20 and 10 respectively.

Mid Semester Examination (MSE) :**Theory Papers:**

- The MSE is conducted for 50 marks of 2 hours duration.
- Question paper pattern; Five out of Six questions have to be answered. Each question carries 10 marks.

Laboratory / Practical Papers:

The MSE is conducted for 50 marks of 2 hours duration. Writing, Execution and Viva - voce will carry weightage of 20, 20 and 10 respectively.

Holistic Education:

End Semester Examination	25 Marks
Participation	25 Marks
Total	50 Marks

15. COURSE STRUCTURE:**B.Tech MECHANICAL****I SEMESTER****CHEMISTRY CYCLE**

S. No.	Course No.	Course Name	Marks	Credit
1	MA131	Mathematics – I	100	4
2	CH132	Engineering Chemistry	100	4
3	EC133	Basic Electronics	100	4
4	CS134	Computer Concepts & C Programming	100	4
5	ME135	Elements of Mechanical Engineering	100	4
6	HE171	Holistic Education-I	---	1
7	ME151	Workshop Practice	50	2
8	CS152	Computer Programming Lab	50	2
9	CH153	Engineering Chemistry Lab	50	2
		TOTAL	650	27

I SEMESTER**PHYSICS CYCLE**

S. No.	Course Code	Course Name	Marks	Credits
1	MA131	Mathematics – I	100	4
2	PH132	Engineering Physics	100	4
3	EE133	Basic Electrical Engineering	100	4
4	CV134	Engineering Mechanics	100	4
5	EG135	Engineering Graphics	100	4
6	PD136	Professional Development-I	100	4
7	HE171	Holistic Education-I		1
8	PH151	Engineering Physics Lab	50	2
9	EE152	Basic Electrical Engineering Lab	50	2
		TOTAL	700	29

SEMESTER II**CHEMISTRY CYCLE**

S. No.	Course Code	Course Name	Marks	Credits
1	MA231	Mathematics – II	100	4
2	CH232	Engineering Chemistry	100	4
3	EC233	Basic Electronics	100	4
4	CS234	Computer Concepts & C Programming	100	4
5	ME235	Elements of Mechanical Engineering	100	4
6	HE271	Holistic Education-II		1
7	ME251	Workshop Practice	50	2
8	CS252	Computer Programming Lab	50	2
9	CH253	Engineering Chemistry Lab	50	2
		TOTAL	650	27

SEMESTER II**PHYSICS CYCLE**

S. No.	Course Code	Course Name	Marks	Credits
1	MA231	Mathematics – II	100	4
2	PH232	Engineering Physics	100	4
3	EE233	Basic Electrical Engineering	100	4
4	CV234	Engineering Mechanics	100	4
5	EG235	Engineering Graphics	100	4
6	PD236	Professional Development-I	100	4
7	HE271	Holistic Education-II	---	1
8	PH251	Engineering Physics Lab	50	2
9	EE252	Basic Electrical Engineering Lab	50	2
		TOTAL	700	29

SEMESTER III

S. No	Course No	Course Name	Marks	Credit
1	ME331	Mathematics -III	100	4
2	ME332	Material Science and Metallurgy	100	4
3	ME333	Basic Thermodynamics	100	4
4	ME334	Mechanics of Materials	100	4
5	ME335	Manufacturing Process-I	100	4
6	ME336	Professional Development	100	4
7	ME351	Metallographic &Material Testing Laboratory	50	2
8	ME352	Foundry & Forging Laboratory	50	2
9	HE371	Holistic Education-III	----	1
		TOTAL	700	29

SEMESTER IV

S. No	Course No	Course Name	Marks	Credit
1	ME431	Mathematics-IV	100	4
2	ME 432	Applied Thermodynamics	100	4
3	ME433	Kinematics of Machines	100	4
4	ME434	Manufacturing Process-II	100	4
5	ME435	Fluid Mechanics	100	4
6	ME436	Mechanical Measurements and Metrology	100	4
7	ME451	Mechanical Measurements and Metrology Laboratory	50	2
8	ME452	Machine Shop	50	2
9	HE471	Holistic Education-IV	----	1
		TOTAL	700	29

SEMESTER V

S. No	Course No	Course Name	Marks	Credit
1	ME531	Design of Machine Elements-I	100	4
2	ME532	Energy Engineering	100	4
3	ME533	Dynamics of Machines	100	4
4	ME534	Turbo Machines	100	4
5	ME535	Manufacturing Process-III	100	4
6	ME536	Computer Aided Machine Drawing	100	4
7	ME551	Fluid Mechanics and Machines Laboratory	50	2
8	ME552	Energy Conversion Engineering Laboratory	50	2
		TOTAL	700	28

SEMESTER VI

S. No	Course No	Course Name	Marks	Credit
1	ME31	Design of Machine Elements – II	100	4
2	ME632	Heat and Mass Transfer	100	4
3	ME633	Finite Element Methods	100	4
4	ME634	Mechatronics & Microprocessor	100	4
5	ME635	Elective-I	100	4
6	ME636	Hydraulics and Pneumatics	100	4
7	ME651	Heat & Mass Transfer Laboratory	50	2
8	ME652	Computer Aided Modeling and Analysis Laboratory	50	2
		TOTAL	700	28

SEMESTER VII**(2012-13, 2013-14 and 2014-15 batches only)**

S. No	Course No	Course Name	Marks	Credit
1	ME731	Engineering Economy	100	4
2	ME732	Mechanical Vibrations	100	4
3	ME733	Operations Research	100	4
4	ME734	Industrial Robotics	100	4
5	ME735	Elective-II	100	4
6	ME736	Elective-III	100	4
7	ME751	Design Laboratory	50	2
8	ME752	CIM & Automation Laboratory	50	2
9	ME771	Internship	--	2
		TOTAL	700	30

VII Sem**(2010-11, 2011-12 batches only)**

S. No	Course No	Course Name	Marks	Credit
1	ME731	Engineering Economy	100	4
2	ME732	Mechanical Vibrations	100	4
3	ME733	Operations Research	100	4
4	ME734	Industrial Robotics	100	4
5	ME735	Elective-II	100	4
6	ME736	Elective-III	100	4
7	ME751	Design Laboratory	50	2
8	ME752	CIM & Automation Laboratory	50	2
		TOTAL	700	28

SEMESTER VIII

(2011-12, 2012-13, 2013-14 and 2014-15 batches)

S. No	Course No	Course Name	Marks	Credit
1	ME 831	Operations Management	100	4
2	ME832	Control Engineering	100	4
3	ME833	Elective-IV	100	4
4	ME871	Project Work	200	6
5	ME872	Comprehension	50	2
6	BTCY01	Cyber Security	--	2
		TOTAL	550	22

LIST OF ELECTIVES**ELECTIVE- I (ME635)**

Course No	Course Name	Marks	Credit
ME635	Theory of Elasticity	100	4
ME635	Mechanics of Composite Materials	100	4
ME635	Refrigeration and Air Conditioning	100	4
ME635	Design of Heat Exchanger	100	4
ME635	Non-Traditional Machining	100	4
ME635	Project Management	100	4
ME635	Statistical Quality Control	100	4

ELECTIVE –II (ME735)

Course No	Course Name	Marks	Credit
ME735	Mechanism Design	100	4
ME735	Theory of Plasticity	100	4
ME735	Engineering Design	100	4
ME735	Gas Dynamics	100	4
ME735	Automation in Manufacturing	100	4
ME735	Total Quality Management	100	4

ELECTIVE-III (ME736)

Course No	Course Name	Marks	Credit
ME736	Experimental Stress Analysis	100	4
ME736	Cryogenics	100	4
ME736	Smart Materials	100	4
ME736	Agile Manufacturing	100	4
ME736	Financial Management	100	4
ME736	Internal Combustion Engines	100	4

ELECTIVE –IV (ME833)

Course No	Course Name	Marks	Credit
ME833	Tribology	100	4
ME833	Fracture Mechanics	100	4
ME833	Power Plant Engineering	100	4
ME833	Nanotechnology	100	4
ME833	Organizational Behavior & Professional Communication	100	4
ME833	Automotive Engineering	100	4

MATHEMATICS - I**MA 131****PAPER DESCRIPTION:**

This paper contains five units which are Matrix Theory, Differential and Integral Calculus, Differential Equation and Vector Calculus. This paper aims at enabling the students to know various concepts and principles of calculus. Successive differentiation to any order, calculus of functions of several variables, application of calculus to find area, volume etc and drawing complicated curves, classification of different type of differential equation with an introduction to vector calculus are covered in this paper.

PAPER OBJECTIVES:

This course is addressed to those who intend to apply the subject at the proper place and time, while keeping him/her aware to the needs of the society where he/she can lend his/her expert service, and also to those who can be useful to the community without even going through the formal process of drilling through rigorous treatment of mathematics.

UNIT –I:**Matrix Theory****12 Hours**

Basic concepts of matrix, matrix addition, scalar multiplication, matrix multiplication; Inverse of a matrix; Determinants; Systems of linear equations, Eigenvalues, eigenvectors, and applications, Cayley – Hamilton Theorem; Symmetric, skew-symmetric, and orthogonal matrices, Hermitian, skew-Hermitian and unitary matrices; Properties of eigenvalues, diagonalization

UNIT - II:**Differential Calculus - I****10 Hours**

n^{th} order derivative of standard functions. Leibnitz's theorem (without proof) and Problems.

Partial Derivatives, Euler's Theorem. Total differentiation. Differentiation of Composite and implicit functions. Jacobians and their properties.

UNIT - III:**Integral Calculus – I****14 Hours**

Reduction formulae for the integration of $\sin^n x$, $\cos^n x$, $\tan^n x$, $\cot^n x$, $\sec^n x$, $\operatorname{cosec}^n x$ and $\sin mx \cos nx$ and evaluation of these integrals with standard limits - Problems. Tracing of standard curves in Cartesian, Parametric and Polar form.

Derivative of arc length, Applications of integration to find surfaces of revolution and volumes of solids of revolution.

UNIT – IV:**Differential Equation - I****10 Hours**

Solution of first order and first degree differential equations: homogeneous, linear, Bernoulli and exact equations, Newton's law of cooling, Growth and Decay Problems.

UNIT –V:**Vector Calculus - I****14 Hours**

Vector differentiation. Velocity, Acceleration of a particle moving on a space curve. Vector point function. Gradient, Divergence, Curl, Laplacian. Solenoidal and Irrotational vectors - Problems.

ESSENTIAL READING

1. Dr. B. S. Grewal, "Higher Engineering Mathematics", 39th Edition, Khanna Publishers, July 2005.
2. K. A. Stroud, "Engineering Mathematics", 6th Edition, Palgrave Macmillan, 2007.

RECOMMENDED READING

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, 2005
2. Thomas and Finney, "Calculus", 9th Edition, Pearson Education, 2004
3. Peter V. O'Neil, "Advanced Engineering Mathematics", Thomson Publication, Canada, 2007
4. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw – Hill, 2009.
5. Michael Artin, "Algebra", 2nd Edition, Prentice Hall of India Private Limited, New Delhi, 2002
6. Kenneth Hoffman and Ray Kunze, "Linear Algebra", 2nd Edition, Prentice Hall of India Private Limited, New Delhi, 2002
7. George F. Simmons and Steven G. Krantz, "Differential Equation, Theory, Technique and Practice", Tata McGraw – Hill, 2006.
8. M. D. Raisinghania, "Ordinary and Partial Differential Equation", Chand (S.) & Co. Ltd., India, March 17, 2005.
9. H. K. Das & Rajnish Verma, "Higher Engineering Mathematics", S. Chand & Company Ltd., 2011.

ENGINEERING CHEMISTRY – CH 132 / CH 232*(Common for all branches)***PAPER DESCRIPTION:**

This paper contains five units which are Chemical Energy Sources, Solar Energy, Electrochemical Energy Systems, Conversion and Storage of Electrochemical Energy Systems, Corrosion of Science and Control. Metal finishing and Electroless plating, Liquid Crystals and their Applications, High polymers and Water Technology. This paper aims at enabling the students to know various energy sources. Corrosion and its control metal finishing. and method of plating, crystals and their applications, types of polymers and water technology covered in this paper.

PAPER OBJECTIVES:

- To familiarise the students on application oriented themes like the chemistry of materials used in engineering discipline
- To focus the students on the chemistry of compounds resulting from pollution, waste generation and environmental degradation and to apply the knowledge in solving these current environmental problems effectively.

LEVEL OF KNOWLEDGE: *Basic***UNIT – I: CHEMICAL ENERGY SOURCES****9 Hours**

Introduction to energy; Fuels - definition, classification, importance of hydrocarbons as fuels; Calorific value-definition, Gross and Net calorific values (SI units). Determination of calorific value of a solid / liquid fuel using Bomb calorimeter. Petroleum cracking-fluidised catalytic cracking. Reformation of petrol. Knocking - mechanism, octane number, cetane number, prevention of knocking, anti-knocking agents, unleaded petrol; synthetic petrol – Bergius process and Fischer Tropsch process; power alcohol. Solar Energy : Photovoltaic cells- Introduction, definition, importance, working of a PV cell; solar grade silicon, physical and chemical properties of silicon relevant to photovoltaics, production of solar grade (crystalline) silicon and doping of silicon.

UNIT – II: ELECTROCHEMICAL ENERGY SYSTEMS (ELECTRODE POTENTIAL AND CELLS) **7 Hours**

Single electrode potential-definition, origin, sign conventions. Derivation of Nernst equation. Standard electrode potential l-definition. Construction of Galvanic cell-classification - primary, secondary and concentration cells, EMF of a cell-definition, notation and conventions. Reference electrodes-calomel electrode, Ag/AgCl electrode. Measurement of single electrode potential. Numerical problems on electrode potential and EMF. Ion-selective electrode- glass electrode, determination of pH using glass electrode

CONVERSION AND STORAGE OF ELECTROCHEMICAL ENERGY BATTERY TECHNOLOGY **7 Hours**

Batteries-Basic concepts, battery characteristics. Classification of batteries-primary, secondary and reserve batteries. Classical Batteries-Construction working and applications of Zn-air, Nickel-Metal hydride and Lithium-MnO₂ batteries, Fuel Cells - Introduction, types of fuel cells- Alkaline, Phosphoric acid and Molten carbonate fuel cells. Solid polymer electrolyte and solid oxide fuel cells. Construction and working of H₂O₂ and Methanol-Oxygen fuel cell

UNIT – III: CORROSION SCIENCE **7 Hours**

Corrosion - definition, Chemical corrosion and Electro-chemical theory of corrosion, Types of corrosion, Differential metal corrosion, Differential aeration corrosion (pitting and water line corrosion), Stress corrosion. Factors affecting the rate of corrosion, Corrosion control: Inorganic coatings – Anodizing and Phosphating, Metal coatings –Galvanization and Tinning, Corrosion Inhibitors, Cathodic and Anodic protection

METAL FINISHING **7 Hours**

Technological importance of metal finishing. Significance of polarization, decomposition potential and over-voltage in electroplating processes. Electroplating – Process, Effect of plating variables on the nature of electro deposit, surface preparation and electroplating of Cr and Au.

Electroless Plating, Distinction between electroplating and electroless plating, advantages of electroless plating. Electroless plating of copper on PCB and Nickel

UNIT – IV LIQUID CRYSTALS AND THEIR APPLICATIONS: 6 Hours

Introduction, classification-Thermotropic and Lyotropic with examples. Types of mesophases-nematic, chiral nematic (cholesteric), smectic and columnar. Homologues series (PAA and MBBA); Applications of liquid crystals in display systems

HIGH POLYMERS: 7 Hours

Definition, Classification - Natural and synthetic with examples. Polymerization – definition, types of polymerization – Addition and Condensation with examples. Mechanism of polymerization - free radical mechanism (ethylene as an example), Methods of polymerization - bulk, solution, suspension and emulsion polymerization. Glass transition temperature, structure and property relationship. Compounding of resins. Synthesis, properties and applications of Teflon. PMMA, Polyurethane and Phenol – formaldehyde resin. Elastomers - Deficiencies of natural rubber and advantages of synthetic rubber. Synthesis and application of Neoprene, Butyl rubber. Adhesives- Manufacture and applications of Epoxy resins. Conducting polymers - definition, mechanism of conduction in polyacetylene. Structure and applications of conducting Polyaniline

UNIT – V WATER TECHNOLOGY: 7 Hours

Impurities in water, Water analysis - Determination of different constituents in water - Hardness, Alkalinity, Chloride, Fluoride, Nitrate, Sulphate and Dissolved Oxygen. Numerical problems on hardness and alkalinity. Biochemical Oxygen Demand and Chemical Oxygen Demand. Numerical problems on BOD and COD. Sewage treatment. Potable water, purification of water - Flash evaporation, Electro dialysis and Reverse Osmosis. Hazardous chemicals with ill effects

INSTRUMENTAL METHODS OF ANALYSIS: 2 Hours

Theory, Instrumentation and Applications of Colorimetry, Potentiometry, Conductometry

ESSENTIAL READINGS

1. Dr. B.S. Jai Prakash, "Chemistry for Engineering Students", Subhas Stores, Bangalore, Revised Edition 2009
2. M. M. Uppal, "Engineering Chemistry", Khanna Publishers, Sixth Edition, 2001
3. Jain and Jain, "A text Book of Engineering Chemistry", S. Chand & Company Ltd. New Delhi, 2009

RECOMMENDED READING

- (i) Alkins P.W. "physical chemistry" ELBS IV edition 1998, London
- (ii) F. W. Billmeyer, "Text Book of Polymer Science", John Wiley & Sons, 1994
- (iii)G. W. Gray and P. A. Winsor, "Liquid crystals and plastic crystals", Vol - I, Ellis Horwood series in Physical Chemistry, New York. (P. No. 106-142)
- (iv)M. G. Fontana, "Corrosion Engineering", Tata Mc Graw Hill Publications 1994.
- (v) Stanley E. Manahan, "Environmental Chemistry", Lewis Publishers, 2000
- (vi)B. R. Puri, L. R. Sharma & M. S. Pathania, "Principles of Physical Chemistry", S. Nagin Chand & Co., 33rd Ed.,1992

BASIC ELECTRONICS – EC 133

(Common for all branches)

PAPER DESCRIPTION:

The course aims to develop the skills of the students in the areas of electronics by learning fundamentals. This will be necessary for their effective studies in a large number of engineering subjects like Electronics circuits and devices, Digital Electronics, communication systems. The course will also serve as a prerequisite for post graduate and specialized studies and research.

PAPER OBJECTIVES:

- *To impart basic knowledge about electronic and digital systems*
- *To give basic ideas about various communication systems*

LEVEL OF KNOWLEDGE: *Basic*

UNIT – I:**Introduction to semiconductors and basic diode theory****9 + 3 Hours**

Conductors, semiconductors and insulators, Intrinsic and Extrinsic semiconductors, Flow of charge carriers in a semiconductor, energy levels and barrier potential, PN junction as a diode, Unbiased diode, forward bias diode, reverse bias, VI characteristics of a diode, Variation of diode parameters with temperature. Ideal diodes, diode approximations, resistance of a diode, Load lines, comparison between Silicon and Germanium

UNIT – II:**Semiconductor diode applications****9 + 3 Hours**

Half-wave rectifier, ripple factor and efficiency, Full-wave and bridge rectifier, ripple factor and efficiency, Peak inverse voltage, working of capacitor input filter, Approximate analysis of capacitor filter, Zener diode characteristics, Zener and Avalanche breakdown, Zener diode voltage regulator, power supply performance

UNIT – III :**Bipolar Junction Transistors****9 + 3 Hours**

Bipolar junction transistor, transistor voltages and currents, Unbiased transistor, Biased transistor, Transistor configurations- CB, CE, CC, DC load line Base Bias, Collector to Base Bias, Voltage divider Bias, Comparison of basic bias circuits, Bias circuit design, Comparison of basic bias circuits, Single stage CE amplifier, Decibel voltage gain, power gain, Half Power points

UNIT – IV :**Introduction to Operational Amplifiers & Oscillators****9 + 3 Hours**

Block diagram, Op-amp transfer characteristics, Basic Op-amp parameters and its value for IC 741- offset voltage and current, input and output impedance, Gain, slew rate, bandwidth, CMRR, Concept of negative feedback, Inverting and Non-inverting amplifiers, Summing Amplifier, Subtractor, integration, differentiation, Voltage follower, the Barkhausen Criterion for Oscillations, BJT RC phase shift oscillator, Hartley Colpitts and crystal oscillator, Numerical problems as applicable.

UNIT – V :**Digital Electronics****9 + 3 Hours**

Introduction, decimal system, Binary, Octal and Hexadecimal number systems, addition and subtraction, fractional number, Binary Coded Decimal numbers. Boolean algebra, Logic gates, Half-adder, Full-adder, Parallel Binary adder.

ESSENTIAL READING

1. Albert Malvino, David. J. Bates, “Electronic Principles”, 7th Edition, Tata McGraw Hill, 2007
2. David. A. Bell, “Electronic Devices and Circuits”, PHI, New Delhi, 2004
3. Albert Paul Malvino, Donald P Leach, Goutamsaha, “Digital Principles and applications”, 6th Edition, Tata McGraw Hill, 2007.

4. Roy Choudhary and Shail Jain, "Linear Integrated Circuits", Third Edition, New Age international Publishers, 2007

RECOMMENDED READING

1. Jacob Millman, Christos C. Halkias "Electronic Devices and Circuits", TMH, 1991 Reprint 2001
2. Morris Mano, "Digital Logic and Computer Design", PHI, EEE

PROBLEM SOLVING AND PROGRAMMING CONCEPTS – CS 134
(Common for all branches)

PAPER DESCRIPTION:

This paper contains five units which gives the programming concepts of C Language. This paper aims at enabling the students to learn C programming Language in detail.

PAPER OBJECTIVES:

1. *To develop skill in problem solving concepts through learning C programming.*

LEVEL OF KNOWLEDGE: *Basic***Unit – I:****12 Hours****Algorithms and Flowcharts:**

Algorithms, Flowcharts, Divide and conquer strategy. Examples on algorithms and flowcharts. Constants, Variables, and Data types: Characters set, C tokens, Keywords and Identifiers, Constants, Variables, Data types, Declaration of variables.

Operators and Expressions:

Arithmetic operators, Relational operators, Logical operators, Assignment operators, Increment and Decrement operators, Conditional operator, Bitwise operators, Special operators, Arithmetic expressions, Evaluation of expressions, Precedence of Arithmetic operators, Type conversions in expressions, Operator precedence and associativity.

Unit – II:**12 Hours****Managing Input and Output Operations:**

Reading a character, writing a character, Formatted Input, Formatted Output

Decision making and Branching:

Decision making with if statement, Simple if statement, The if...else statement, Nesting of if...else statements, The else ... if ladder, The switch statement, The ?: operator, The Goto statement

Looping: The while statement, The do statement, The for statement, Jumps in Loops

Unit – III:**13 Hours****Arrays:**

One-dimensional Arrays, Declaration of one-dimensional Arrays, Initialization of one-dimensional Arrays, Two-dimensional Arrays, Initializing two-dimensional Arrays.

User-defined Functions:

Need for User-defined Functions, A multi-function Program, Elements of user - defined Functions, Definition of Functions, Return Values and their types, Function Calls, Function Declaration, Category of Functions, No Arguments and no Return Values, Arguments but no Return Values, Arguments with Return Values, No Argument but Returns a Value, Functions that Return Multiple Values.

Unit – IV:**10 Hours****Pointers:**

Understanding the pointers, Accessing the Address of a Variable, Declaring Pointer Variables, Initialization of Pointer Variables, Accessing a Variable through its Pointer, Pointer Expressions, Pointer Increments and Scale Factor, Pointers and Arrays, Pointers and Character Strings, Pointers as Function Arguments, Functions Returning Pointers.

Unit – V:**13 Hours****Strings, Structure, Union, Files:**

Strings: String concepts, C strings, String I/O functions, Array of strings, String manipulation function, Memory formatting, Derived types-Enumerated, Structure, and Union: The type definition, Enumerated types, Structure, Accessing structures, Complex structures, Array of structures, Structures and functions, Union , Files: Classification of Files, Standard Library Functions for Files

ESSENTIAL READING:

1. Deitel and Deitel, "C How to Program", Prentice Hall 2010.
2. Anil Bikas Chaudhuri, "The Art of Programming through Flowcharts and Algorithms", Firewall Media.

RECOMMENDED READING:

1. Introduction to Computer Science, IITL Education Solutions Ltd., Pearson Education, 2007.
2. E. Balagurusamy, “Programming in ANSI C”, Tata McGraw Hill – III Edition.
3. V. Rajaraman, “Fundamentals of Computers”, 4th Edition, PHI 2005.
4. M. G. V. Murthy, “Programming Techniques through C”, Pearson Education, 2007.
5. Yashvant Kanetkar, “Let Us C”, BPB Publications - 8th Edition, 2008.

ELEMENTS OF MECHANICAL ENGINEERING – ME135*(Common for all branches)***PAPER DESCRIPTION:**

Mechanical Engineering basically deals with three basic concepts Design engineering, Thermal engineering & Manufacturing engineering, this subject ELEMENTS OF MECHANICAL ENGINEERING gives the basic insight of theoretically knowledge of these aspects.

PAPER OBJECTIVES:

To familiarize with

- (i) The Source of Energy and Power Generation.*
- (ii) The various metal processing and metal working.*
- (iii)The Basic theory of machine tools.*

LEVEL OF KNOWLEDGE: *Basic*

UNIT – I:**9 Hours****Energy and Steam Forms:**

Sources and Classification of energy, Utilization of energy with simple block diagrams, Steam formation. Types of steam, Steam properties – Specific Volume, Enthalpy and Internal energy. (simple numerical problems) Steam boilers classification, Lancashire boiler, Babcock and Wilcox boiler mountings, accessories, their locations and application. (No sketches for mountings and accessories).

UNIT-II**16 Hours****TURBINES:**

Steam turbines–Classification, Principle of operation of Impulse and reaction. Delaval’s turbine, Parson’s turbine. Compounding of Impulse turbines. Gas turbines – Classification, Working principles and Operations of Open cycle and Closed cycle gas turbines. Water turbines – Classification, Principles and operations of Pelton wheel, Francis turbine and Kaplan turbine

INTERNAL COMBUSTION ENGINES:

Classification, I.C. Engines parts, 2/4 – Stroke Petrol and 4-stroke diesel engines. P-V diagrams of Otto and Diesel cycles. Simple problems on indicated power, brake power, indicated thermal efficiency, brake thermal efficiency, mechanical efficiency and specific fuel consumption.

UNIT – III:**9 Hours****REFRIGERATION AND AIR CONDITIONING:**

Refrigerants, properties of refrigerants, list of commonly used refrigerants. Refrigeration - Definitions - Refrigerating effect, Ton of Refrigeration, Ice making capacity, COP, Relative COP, Unit of Refrigeration. Principle and working of vapor compression refrigeration and vapor absorption refrigeration. Principles and applications of air conditioners, Room air conditioner

UNIT – IV:**16 Hours****LATHE AND DRILLING:**

Machines Lathe - Principle of working of a Centre Lathe. Parts of a lathe. Operations on lathe - Turning, Facing, Knurling, Thread Cutting, Drilling, Taper Turning by Tailstock offset method and Compound slide swiveling method. Specification of Lathe.

Drilling Machine – Principle of working and classification of Drilling Machines. Bench Drilling Machine, Radial Drilling Machine. Operations on Drilling Machine - Drilling, Boring, Reaming, Tapping, Counter Sinking, Counter Boring and Spot facing. Specification of radial drilling machine.

MILLING AND GRINDING MACHINES:

Milling Machine – Principle of Milling, Types of Milling Machines. Principle & Working of Horizontal and Vertical Milling Machines. Milling Processes - Plane Milling, End Milling, Slot Milling, Angular Milling, Form Milling, Straddle Milling and Gang Milling. Specification of Universal Milling Machine.

Grinding Machine – Principle and classification of Grinding Machines. Abrasives - Definition, types and Applications. Bonding Materials. Type of Grinding Machines, Principle and Working of Surface Grinding, Cylindrical Grinding and Centerless Grinding.

UNIT – V:**10 Hours****JOINING PROCESSES, LUBRICATION AND BEARINGS:**

Soldering, Brazing and Welding, Definitions. Classification and method of Soldering, Brazing and Welding and Differences. Brief Description of Arc Welding and Oxy - Acetylene Welding Lubrication and Bearings Lubricants - Classification and properties. Screw cap, Tell - Tale, Drop

feed, Wick feed and Needle Lubricators. Ring, Splash and Full pressure lubrication. Classification of Bearings, Bushed bearing, Pedestal bearing, Pivot bearing, Collar Bearings and Antifriction Bearings.

POWER TRANSMISSION: Belt Drives - Classification and applications, Derivations on Length of belt. Definitions - Velocity ratio, Creep and slip, Idler pulley, stepped pulley and fast & loose pulley. Gears - Definitions, Terminology, types and uses. Gear Drives and Gear Trains – Definitions and classifications, Simple problems.

ESSENTIAL READINGS:

1. K.R. Gopalkrishna, “A text Book of Elements of Mechanical Engineering”, Subhash Publishers, Bangalore.
2. S. Trymbaka Murthy, “A Text Book of Elements of Mechanical Engineering”, 3rd revised edition, I .K. International Publishing House Pvt. Ltd., New Delhi. 2010.
3. Dr. R. P. Reddy, N. Kapilan, “Elements of Mechanical Engineering”, 1st Edition, Himalaya Publishing House, New Delhi.

RECOMMENDED READING:

1. SKH Chowdhary, AKH Chowdhary, Nirjhar Roy, “The Elements of Workshop Technology”, Vol. I & II, Media Promoters and Publishers, Mumbai.
2. Ghosh Mallik, “Manufacturing Technology”, TMH. HMT, Production Technology, TMH

HOLISTIC EDUCATION- HE 171

(Common for all branches)

PAPER DESCRIPTION:

This paper contains three units which are Introduction to Life skills, Personal skills, Inter-personal Skills and Societal Skills. This paper aims at enabling the students to various skills in life.

PAPER OBJECTIVE:

- *Holistic development of the individual adult in every student*
- *Knowing life and its principles*
- *Broadening the outlook to life*
- *Training to face the challenges of life*
- *Confidence creation and personality development*
- *Emotional control and stress management*
- *Creating awareness on duties, rights and obligations as member of the Society*
- *Realizing Personal Freedom-its limits and limitations*
- *Developing the attitude to be a contributor and giver*
- *Realizing the real happiness in life*

LEVEL OF KNOWLEDGE: *Basic***1. INTRODUCTION TO LIFE SKILLS (I Semester)****4 Hours****2. PERSONAL SKILLS**

- Creative thinking and Problem solving (I Semester)
- Critical thinking and Decision making(I Semester)
- Study skills and Time management(II Semester)
- Health (II Semester)

3. INTER-PERSONAL SKILLS**4 Hours**

- Non verbal Communication(I Semester)
- Empathy and active listening(I Semester)
- Assertiveness Training (II Semester)
- Conflict Management(II Semester)

4. SOCIETAL SKILLS**4 Hours**

- Human Rights(I Semester)
- Civil Society and Civic sense(I Semester)
- Equality and Justice(II Semester)
- Gender Sensation(II Semester)

ESSENTIAL READING: Holistic Education by Christ College publication, Bangalore-560029

WORKSHOP PRACTICE – ME 151
(Common for all branches)

PAPER DESCRIPTION:

This paper provides working knowledge of fitting welding, sheet metal and carpentry.

PAPER OBJECTIVES:

To provide the students with the hands on experience on different trades of engineering like fitting, welding, carpentry & sheet metal.

LEVEL OF KNOWLEDGE: Working**1. Fitting**

- a) Study of fitting tools
- b) Study of fitting operations & joints
- c) Minimum 5 models involving rectangular, triangular, semi circular and dovetail joints.

2. Welding

- d) Study of electric arc welding tools & equipments
- e) Minimum 4 Models - electric arc welding - Butt joint, Lap joint, T joint & L joint.

3. Sheet Metal

- f) Study of development of surfaces
- g) Minimum 03 models (Tray,Funnel,Cone)

4. Study and demonstration of Carpentry tools, joints and operations.

ESSENTIAL READING:

S. K. H. Choudhury, A. K. H. Choudhury, Nirjhar Roy, “The Elements of Workshop Technology”, Vol 1 & 2, Media Publishers, Mumbai

COMPUTER PROGRAMMING LABORATORY- CS152**(Common for all branches)****PAPER DESCRIPTION:**

Paper contains the programs which include Operations in C, Loop Control Structures, and Function sand file handling methods. This paper aims at enabling the students to know fundamentals of computer concepts and C programming.

PAPER OBJECTIVES:

- *To impart the basic concepts of computer and information technology*
- *To develop skill in problem solving concepts through learning C programming in practical approach.*

LEVEL OF KNOWLEDGE: Basic/working**PART- A**

- Write a C program to find and output all the roots of a given quadratic equation, for non-zero coefficients. (Using if...else statement)
- Write a C program to simulate a simple calculator that performs arithmetic operations like addition, subtraction, multiplication, and division only on integers. Error message should be reported, if any attempt is made to divide by zero. (Using switch statement)
- Write a C program to generate and print first 'N' Fibonacci numbers. (Using looping constructs)
- Write a C program to find the GCD and LCM of two integers and output the results along with the given integers. Use Euclid's algorithm. (Using looping constructs)

- Write a C program to reverse a given four digit integer number and check whether it is a palindrome or not. Output the given number with suitable message. (Using looping constructs)
- Write a C program to find whether a given number is prime or not. Output the given number with suitable message. (Using looping constructs)

PART - B

- Write a C program to input N real numbers in into a single dimension array. Conduct linear search for a given key integer number and report success or failure in the form of a suitable message.
- Write a C program to input N integer numbers into a single dimension array. Sort them in ascending order using bubble sort technique. Print both the given array and the sorted array with suitable headings.
- Write a C program to evaluate the given polynomial $f(x) = a_4x^4 + a_3x^3 + a_2x^2 + a_1x^1 + a_0$ for given value of x and the coefficients using Horner's method. (Using single dimension arrays to store coefficients)
- Write a C program to input N real numbers in ascending order into a single dimension array. Conduct a binary search for a given key integer number and report success or failure in the form of a suitable message.
- Write a C program to input N integer numbers into a single dimension array. Sort them in ascending order using bubble sort technique. Print both the given array and the sorted array with suitable headings.
- Write C user defined functions
 - i. To input N real numbers into a single dimension array.
 - ii. Compute their mean.
 - iii. Compute their variance
 - iv. Compute their standard deviation.

Using these functions, write a C program to input N real numbers into a single dimension array, and compute their mean, variance & standard deviation. Output the computed results with suitable headings.

- Write C user defined functions
 - i. To read the elements of a given matrix of size M x N.
 - ii. To print the elements of a given matrix of size M x N.
 - iii. To compute the product of two matrices.

Using these functions, write a C program to read two matrices A(M x N) and B(P x Q) and compute the product of A and B after checking compatibility for multiplication. Output the input matrices and the resultant matrix with suitable headings and format (Using two dimension arrays)

- Write a C program to read a matrix A(M x N) and to find the following using user defined functions:
 - i. Sum of the elements of the specified row.
 - ii. Sum of the elements of the specified column.
 - iii. Sum of all the elements of the matrix.

Output the computed results with suitable headings.

- Write a C Program to create a sequential file with at least 5 records, each record having USN, name, mark1, mark2, and mark3. Write necessary functions
 - i. To display all the records in the file.
 - ii. To search for a specific record based on the USN. In case the record is not found, suitable message should be displayed. Both the options in this case must be demonstrated.

ENGINEERING CHEMISTRY LABORATORY- CH153 / CH253

(Common for all branches)

PAPER DESCRIPTION:

This paper contains eleven experiments and aims at enabling the students to Practical Engineering Chemistry.

PAPER OBJECTIVES:

- 1. To equip the students with the working knowledge of chemical principles, nature and transformation of materials and their applications.*
- 2. To develop analytical capabilities of students so that they can understand the role of chemistry in the field of Engineering and Environmental Sciences*

LEVEL OF KNOWLEDGE: *Basic/working*

(For Examination, one experiment from Part-A and Part-B shall be set. Different experiments may be set from Part-A and common experiment from Part-B).

PART-A

- Determination of viscosity coefficient of a given liquid using Ostwald's viscometer.
- Estimation of copper by colorimetric method using spectrophotometer.
- Conductometric estimation of strength of an acid using standard NaOH solution
- Determination of pKa value of a weak acid using pH meter.
- Potentiometric estimation of FAS using standard $K_2Cr_2O_7$ solution.

PART-B

- Determination of Total Hardness of a sample of water using disodium salt of EDTA.
- Determination of Calcium Oxide (CaO) in the given sample of cement by Rapid EDTA method.
- Determination of percentage of Copper in brass using standard sodium thiosulphate solution.
- Determination of Iron in the given sample of Haematite ore solution using potassium dichromate crystals by
external indication method.
- Determination of Chemical Oxygen Demand (COD) of the given industrial waste Water sample. (for demonstration)

6. Determination of Dissolved Oxygen in the given water sample by Winkler method. (for demonstration)

Examination – First experiment is a common experiment from Part B. Second experiment is different, from Part A or Part B.

RECOMMENDED READING:

1. J. Bassett, R.C. Denny, G.H. Jeffery, "Vogels text book of quantitative inorganic analysis", 4th Edition

2. SUNITA AND RATAN "PRACTICAL ENGINEERING CHEMISTRY"

MATHEMATICS – II MA231**Paper Description:**

This paper contains five units which are Analytical Geometry in three dimensions, Differential Calculus, Multiple integrals, Differential Equation of higher order and Laplace transformation and its Inverse with Vector integration. This paper aims at enabling the students to study the application of integration to various fields along with the different techniques to solve higher order linear differential equation.

Paper objectives:

Mathematics is a necessary avenue to scientific knowledge which opens new vistas of mental activity. A sound knowledge of engineering mathematics is a 'sine qua non' for the modern engineer to attain new heights in all aspects of engineering practice. This course provides the student with plentiful opportunities to work with and apply the concepts, and to build skills and experience in mathematical reasoning and engineering problem solving.

UNIT –I: Analytical Geometry in three dimensions**10 Hours**

Direction cosines and direction ratios. Planes, Straight lines, Angle between planes / straight lines, Coplanar lines. Shortest distance between two skew lines

UNIT – II: Differential Calculus – II**10 Hours**

Polar curves and angle between Polar curves. Pedal equations of polar curves, Radius of curvature – Cartesian, parametric, polar and pedal forms.

UNIT –III: Integral Calculus – II**12 Hours**

Double integrals, Cartesian and polar co – ordinates, change of order of integration, change of variables between cartesian and polar co – ordinates, triple integration, area as a double integral, volume as a triple integral

UNIT –IV: Differential Equations - II and Vector Calculus – II**14 Hours**

Linear differential equations of second and higher order with constant coefficients. Method of undetermined coefficients. Method of variation of parameters.

Vector Integration - Green's theorem in a plane, Gauss's divergence theorems, Stoke's, (without proof) and simple application.

UNIT -V: Laplace Transforms**14 Hours**

Definition - Transforms of elementary functions. Derivatives and integrals of transforms- Problems. Periodic function. Unit step function and unit impulse function Inverse transforms – Properties. Solutions of linear differential equations

ESSENTIAL READING

1. Dr. B. S. Grewal, "Higher Engineering Mathematics", 39th Edition, Khanna Publishers, July 2005.
2. K. A. Stroud, "Engineering Mathematics", 6th Edition, Palgrave Macmillan, 2007.

RECOMMENDED READING

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, 2005
2. Thomas and Finney, "Calculus", 9th Edition, Pearson Education, 2004
3. Peter V. O'Neil, "Advanced Engineering Mathematics", Thomson Publication, Canada, 2007
4. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw – Hill, 2009.
5. George F. Simmons and Steven G. Krantz, "Differential Equation, Theory, Technique and Practice", Tata McGraw – Hill, 2006.
6. M. D. Raisinghania, "Ordinary and Partial Differential Equation", Chand (S.) & Co. Ltd., India, March 17, 2005.
7. H. K. Das & Rajnish Verma, "Higher Engineering Mathematics", S. Chand & Company Ltd., 2011.

ENGINEERING PHYSICS – PH232

(Common for all branches)

PAPER DESCRIPTION:

This paper contains five UNITS which are

- *Modern Physics and Quantum Mechanics*
- *Conductivity in Metals(Electrical and thermal)*
- *Elastic, Dielectric, Magnetic and Optical Properties of Materials*
- *Lasers, Optical Fibers and Ultrasonics*
- *Crystal Structure and Modern Engineering materials.*

This paper aims at enabling the students to know fundamentals covered in this paper.

PAPER OBJECTIVES:

- *To impart the basic concepts and ideas in physics.*
- *To develop scientific attitudes and enable the students to correlate the concepts of physics with the core programmes.*

LEVEL OF KNOWLEDGE: *Basic/working.*

UNIT – I**14 Hours****Modern Physics**

Introduction to Blackbody radiation spectrum - Planck's theory(qualitative) – Deduction of Wien's displacement law and Rayleigh Jean's law from Planck's theory – Quantum theory applied to Einstein's Photo-electric effect - Photo Multiplier Tube -Compton effect - Wave particle Dualism -de Broglie hypothesis – de Broglie wavelength - extension to electron particle – Davisson and Germer Experiment - Matter waves and their Characteristic properties. Phase velocity, group velocity and Particle velocity. (qualitative).Elementary particles – QUARKS – Types – Properties.

Quantum Mechanics

Heisenberg's uncertainty principle and its physical significance(no derivation). Application of uncertainty principle (Non-existence of electron in the nucleus).

Wave function. Properties and Physical significance of a wave function Schroedinger's - Time independent wave equation – Application: Setting up of a one dimensional Schrödinger wave

equation of a particle in a potential well of infinite depth : Probability density and Normalisation of wave function – Energy eigen values and eigen function.

UNIT – II**11 Hours****Conductivity in metals – Electrical and Thermal**

Classical free-electron theory. Assumptions. Drift velocity. Mean collision time and mean free path. Relaxation time. Expression for drift velocity. Expression for electrical conductivity in metals. Effect of impurity and temperature on electrical resistivity of metals. Failure of classical free-electron theory. Thermal Conductivity. Wiedmann-Franz Law(relation between thermal conductivity & electrical conductivity).

Quantum free-electron theory - Assumptions. Fermi - Dirac Statistics. Fermi-energy – Fermi factor. Density of states (with derivation). Carrier concentration in metals. Expression for electrical resistivity/conductivity Temperature dependence of resistivity of metals. Merits of Quantum free – electron theory.

UNIT – III**12 Hours****Properties of Materials**

Elasticity: Elasticity – types of moduli of elasticity – stress strain diagram – Young’s modulus of elasticity – rigidity modulus – bulk modulus – Poisson’s ratio –Bending of beams – Single Cantilever - Young’s modulus-Non uniform bending.

Dielectric: Dielectric constant and polarisation of dielectric materials. Types of polarisation. Equation for internal fields in liquids and solids (one dimensional). Clausius – Mossotti equation. Ferro and Piezo – electricity(qualitative). Frequency dependence of dielectric constant. Important applications of dielectric materials.

Optics : Phenomenon of diffusion, absorption and scattering of a light – Snell’s Law - Interference – thin films - Air wedge theory and experiment Testing of flat surfaces. Anti reflection coating single and multi layer.

UNIT – IV**12 Hours**

Lasers : Principle and production. Einstein’s coefficients (expression for energy density). Requisites of a Laser system. Condition for Laser action. Principle, Construction and working of

Nd YAG and semiconductor diode Laser. Applications of Laser – Laser welding, cutting and drilling. Measurement of atmospheric pollutants.

Optical Fibers : Principle and Propagation of light in optical fibers. Angle of acceptance. Numerical aperture. Types of optical fibers and modes of propagation. Applications – block diagram discussion of point to point communication.

Ultrasonics : Ultrasonics production – Magnetostriction and Piezoelectric methods – Application (NDT) non-destructive testing of materials- Flaw detection- Measurement of velocity in liquids. Determination of elastic constants in liquids using Ultrasonic Interferometer.

UNIT - V

Material Science

12 Hours

Crystal Structure : Space lattice, Bravais lattice - UNIT cell, primitive cell. Lattice parameters. Crystal systems. Direction and planes in a crystal. Miller indices. Expression for inter-planar spacing. Co-ordination number. Atomic packing factor. Bragg's Law. Determination of crystal structure by Bragg's x-ray spectrometer. Crystal structure of Na Cl.

Modern Engineering Materials:

Metallic Glasses: Properties – Applications.

Shape Memory Alloys : Characteristics - Applications.

Cryogenics : Properties – Applications.

Nano-materials : Molecular Manufacturing. Fabrication technology. Scaling of classical mechanical systems – Basic assumptions. Mechanical scaling. Carbon nano-tubes.

ESSENTIAL READINGS:

1. M.N.Avadhanulu and P.G. Kshirsagar, "A Text Book of Engineering Physics", S.Chand & Company Ltd, 9th Edition 2012.
2. S.O. Pillai, "Solid State Physics", New Age International, 6th Edition 2009.
3. S.P. Basavaraju, "Engineering Physics", Revised Edition 2009.

RECOMMENDED READING:

1. R.K. Gaur and S.L. Gupta, "Engineering Physics", Dhanpatrai and Sons, New Delhi, 2001.

2. Sehgal Chopra Sehgal, “ Modern Physics ”, Tata McGraw-Hill, 6th Edition, 2005.
3. Halliday, Resnick and Krane, "Fundamentals of Physics Extended", John Wiley and Sons Inc., New York, 5th Edition, 1997.
4. P.Mani, “Engineering Physics”, Dhanam publishers, Revised Edition 2011.
5. H.J. Sawant, "Engineering Physics", Technical Publications, 1st Edition, 2010.
6. V. Rajendran, “Engineering Physics”, Tata Mcgraw Hill Publishing Company Limited, 1st Edition, 2009.
7. K.Eric Drexler, “Nanosystems - Molecular Machinery, Manufacturing and Computation”, John Wiely & Sons, 2005.
8. J David, N Cheeke , “Fundamentals and Applications of Ultrasonic Waves”, CRC Press 1st Edition, 2002.
9. Frederick J Bueche and Eugene Hecht “Schaum Outline of Theory and Problems of College Physics”, Tata McGraw-Hill, 11th Edition, 2012.

BASIC ELECTRICAL ENGINEERING –EE233*(Common for all branches)***PAPER DESCRIPTION:**

This paper contains five units which are Analysis of DC circuits, Single phase & three phase A C circuits, DC and AC machines and transformers. This paper aims at enabling the students to provide comprehensive idea about circuit analysis, working principles of machines covered in this paper.

PAPER OBJECTIVES:

At the end of the course students will be able

- To understand the basic concepts of magnetic circuits, AC & DC circuits.*
- To solve the electrical network using mesh and nodal analysis*
- To understand the concept of active, reactive and apparent powers, power factor and resonance in series and parallel circuits.*
- To know the basic concepts of three phase loads and power measurement.*
- To explain the working principle, construction, applications of DC & AC machines*

UNIT – I**12 Hours**

Introduction to electrical power generation and distribution

ELECTRIC CIRCUIT ELEMENTS:

Sources: Ideal voltage source, practical voltage source, ideal current source, practical current source, source transformation, Controlled sources.

Resistor: Resistance, linear and non-linear resistors, resistors in series, resistors in parallel, current division, power consumed by a resistor.

Capacitor: Capacitance, equivalent capacitance of capacitors in series, voltage division, capacitors in parallel, energy stored by a capacitor.

Inductor: Inductance, self-induced emf, energy stored by an inductor, inductors in series, inductors in parallel mutual Inductance, Co-efficient of coupling.

Resistive networks: star- delta and delta – star transformations, network reduction technique.

UNIT – II**12 Hours****SINGLE-PHASE AC CIRCUITS:**

Alternating voltages and currents, generation of single phase alternating voltage, average value and rms value of periodic sinusoidal and non- sinusoidal wave forms, form factor.

Representation of time-varying quantities as phasors; the operator j ; Representation of complex quantities; Addition, subtraction, multiplication and division of phasors.

Basic ac circuits, sinusoidal alternating current in a pure resistor, pure inductor and a pure capacitor, waveforms of voltage, current, and power, phasor diagram, inductive and capacitive reactances.

RL, RC, and RLC circuits, concept of impedance and phasor diagram, expression for average power, power factor, parallel ac circuits, conductance, susceptance and admittance, analysis of series parallel circuits and phasor diagrams, active power, reactive power, and apparent power, complex power and power triangle.

UNIT III**12 Hours****THREE-PHASE AC CIRCUITS:**

Generation of 3-phase balanced sinusoidal voltages, waveform of 3-phase voltages, star and delta connections, line voltage and phase voltage, line current and phase current, analysis of 3-phase circuit with balanced supply voltage and with star/delta connected balanced loads, measurement of active power using two-wattmeter method with balanced loads.

UNIT – IV**12 Hours****ELECTROMAGNETISM:**

Introduction to electromagnetism, comparison of electrical circuit with magnetic circuit, Magnetic flux, Flux density, Fleming's left hand rule, Faraday's laws, Fleming's right hand rule, Lenz's law,

DC MACHINES:

Working principle of DC machine as a generator and motor. Constructional features. E.M.F. equation of generator and illustrative examples. Back E.M.F. and torque equations of D.C. motors. Types of D.C. motors.

UNIT – V**12 Hours**

TRANSFORMERS: Types, constructional features, principle of operation, equation for induced emf, transformation ratio, ideal transformer, transformer under no-load, losses, efficiency, applications.

THREE-PHASE INDUCTION MOTORS:

Types, constructional details, production of rotating magnetic field, synchronous speed, principle operation, slip, Necessity of a starter for 3-phase induction motor, Star –Delta starter.

ESSENTIAL READINGS:

1. Arthur Eugene Fitzgerald, David E. Higginbotham, Arvin Grabel, “Basic electrical engineering: circuits, electronics, machines, controls”, McGraw-Hill, Fifth Edition.
2. E. Hughes; “Electrical Technology”, 9th Edition”, Pearson, 2005.

RECOMMENDED READING:

1. Kothari D. P. & Nagarath I. J, “Basic Electrical Technology”, TMH, 2004
2. Rajendra Prasad, “Fundamentals of Electrical Engineering”, Prentice Hall of India Pvt Ltd., 2005
3. K.A. Krishnamurthy and M.R Raghuvver, “Electrical, Electronics and Computer Engineering”, 2nd Edition, T.M.H., 2001
4. D C Kulshreshtha, “*Basic Electrical Engineering*”, TMH.
5. Abhijit Chakrabarti, Sudipta Nath & Chandan Kumar Chanda, “Basic Electrical Engineering”, TMH, 2009.

ENGINEERING MECHANICS –CV 234

(Common for all branches)

SUBJECT DESCRIPTION:

This paper aims at enabling the students to know the fundamentals Engineering Mechanics covered in this paper. This paper contains five units which are Engineering Mechanics and its classification, Composition of Forces, Equilibrium of Forces, Types of Supports, Analysis of trusses, Centroid and Moment of Inertia and Friction.

SUBJECT OBJECTIVES:

- *The students will understand the basics of Engineering Mechanics*
- *The students will understand the basic principles, laws, measurements, calculations and SI units.*
- *The students will understand mechanics that studies the effects of forces and moments acting on rigid bodies that are either at rest or moving with constant velocity along a straight path for static condition only.*
- *The students will understand the basic concepts of forces in the member, centroid, moment of inertia & friction*

LEVEL OF KNOWLEDGE: *Basic*

UNIT – I:

15 Hours

INTRODUCTION TO ENGINEERING MECHANICS

Basic idealizations – Practical, Continuum, Rigid body and Point force; Newton's laws of motion, Definition of force, Introduction to SI units, Elements of a force, classification of force and force systems; Principle of physical independence of forces, Principle of superposition of forces, Principle of transmissibility of forces; Moment of a couple, characteristics of couple, Equivalent force – couple system; Resolution of forces, composition of forces; Numerical problems on moment of forces and couples, on equivalent force – couple system.

COMPOSITION OF FORCES: Definition of Resultant; Composition of coplanar – concurrent force system, Principle of resolved parts; Numerical problems on composition of coplanar concurrent force systems

COMPOSITION OF COPLANAR: Non-concurrent force system, Varignon's principle of moments; Numerical problems on composition of coplanar non-concurrent force systems.

UNIT – II:

13 Hours

EQUILIBRIUM OF FORCES

Definition of Equilibrant; Conditions of static equilibrium for different force systems, Lami's theorem; Numerical problems on equilibrium of coplanar – concurrent force system.

TYPES OF SUPPORTS: Statically determinate beams, Numerical problems on equilibrium of coplanar-non- concurrent force system and support reactions for statically determinate beams

UNIT – III:

09 Hours

ANALYSIS OF PLANE TRUSSES

Introduction to Determinate and Indeterminate plane trusses - Analysis of simply supported and cantilevered trusses by method of joints and method of sections

UNIT – IV:

15 Hours

CENTROID OF PLANE FIGURES

Locating the centroid of triangle, semicircle, quadrant of a circle and sector of a circle using method of integration, centroid of simple built up sections; Numerical problems.

MOMENT OF INERTIA OF AN AREA: polar moment of inertia, Radius of gyration, Perpendicular axis theorem and Parallel axis theorem; Moment of Inertia of rectangular, circular and triangular areas from method of integration; Moment of inertia of composite areas; Numerical problems.

UNIT – V:

08 Hours

FRICITION:

Types of friction, Laws of static friction, Limiting friction, Angle of friction, angle of repose; Impending motion on horizontal and inclined planes; Wedge friction; Ladder friction; Numerical problems.

ESSENTIAL READINGS

1. Bhavikatti S.S. “Elements of Civil Engineering (IV Edition) and Engineering Mechanics”, 2/E, Vikas Publishing House Pvt. Ltd., New Delhi, 2008
2. Jagadeesh T.R. and Jay Ram, “Elements of Civil Engineering and Engineering Mechanics”, 2/E, Sapana Book House, Bangalore, 2008.
3. Shesh Prakash and Mogaveer, “Elements of Civil Engineering and Engineering Mechanics”, 1/E, PHI learning Private Limited, New Delhi, 2009.

RECOMMENDED READING:

1. Bansal R. K, “Engineering Mechanics”, Laxmi Publications(P) Ltd, New Delhi, 1995
2. Ferdinand P. Beer and E. Russel Johnston Jr., “Mechanics for Engineers: Statics”, 8/E, McGraw-Hill Book Company, New Delhi. 2007
3. Goyal and Raghuvanshi., “Engineering Mechanics”, New Edition, PHI learning Private Limited, New Delhi.
4. Irving H Shames, “Engineering Mechanics”, 4/E, PHI learning Private Limited, New Delhi, 2008
5. Jivan khachane & Ruchishrivastava, “Engineering Mechanics”, Ane’s Student Edition, Anne Book India, New Delhi, 2006.
6. Kolhapure B.K., “Elements of Civil Engineering & Engineering Mechanics”, 1/E, EBPB Publications, Belgaum, 2003.
7. Lakshmana Rao, et al., “Engineering Mechanics - Statics and Dynamics”, New Edition, PHI learning Private Limited, 2009.
8. Meriam J. L, and Kraige., L. G , “Engineering Mechanics”, 5/E, Volume I, Wiley India Edition, India, 2009.
9. Nelson, “Engineering Mechanics”, New Edition, Tata McGraw-Hill Education Pvt. Ltd, 2009
10. Palanichamy M.S., “Engineering Mechanics (Statics & Dynamic)”, 3/E, Tata McGraw-Hill Education Pvt. Ltd, New Delhi, 2008.
11. Sawant H. J, & Nitsure., “Elements of Civil Engineering (IV Edition) and Engineering Mechanics”, New Edition, Technical publications, Pune, India, 2010.

ENGINEERING GRAPHICS – EG235*(Common for all branches)***PAPER DESCRIPTION:**

Provides basic knowledge about Orthographic projections, Projections of points, Projection of lines, Projection of Planes and Projection of Solids, development of Surfaces & isometric projections & also helps students learn Solid Edge.

PAPER OBJECTIVES:

- *To draw and interpret various projections of 1D, 2D and 3D objects..*
- *To prepare and interpret the drawings.*
- *Hands on training in Solid Edge.*

LEVEL OF KNOWLEDGE: *Lettering and dimensioning*

LEARNING OUTCOME:

- *Will be in a position to convert vision /imagination into reality.*
- *Acquires knowledge of scaling.*
- *Can develop plan and elevation of geometrical objects.*
- *Can produce development of surfaces.*
- *Draw isomertic projection ofobjects.*

UNIT - I**6 Hours****Introduction to Computer Aided Sketching:**

Introduction, Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning and free hand practicing. Computer screen, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools. Co-ordinate system and reference planes. Definitions of HP, VP, RPP & LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints viz. tangency, parallelism, inclination and perpendicularity. Dimensioning, line conventions, material conventions and lettering

UNIT – II**15 Hours****Orthogonal Projections:**

Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes (No application problems).

UNIT – III**15 Hours****Orthographic Projections of Plane Surfaces (First Angle Projection Only)**

Introduction, Definitions – projections of plane surfaces – triangle, square, rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change of position method only (No problems on punched plates and composite plates)

UNIT – IV**18 Hours****PROJECTIONS OF SOLIDS:**

Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions. (No problems on octahedrons and combination solid)

UNIT – V**15 Hours****SECTIONS AND DEVELOPMENT OF LATERAL SURFACES OF SOLIDS:**

Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP. (No problems on sections of solids) Development of lateral surfaces of above solids, their frustums and truncations. (No problems on lateral surfaces of trays, tetrahedrons, spheres and transition pieces).

UNIT – VI**15 Hours****ISOMETRIC PROJECTION (USING ISOMETRIC SCALE ONLY):**

Introduction, Isometric scale, Isometric projection of simple plane figures, Isometric projection of tetrahedron, hexahedron(cube), right regular prisms, pyramids, cylinders, cones, spheres, cut spheres and combination of solids (Maximum of three solids).

ESSENTIAL READINGS:

1. K.R. Gopalakrishna, “Engineering Graphics ”, 15th Edition, Subash Publishers Bangalore.
2. Basant Agrawal, C. M. Agrawal, “Engineering Drawing”, TMH.
3. N.D. Bhatt, “Engineering Graphics, Elementary Engineering Drawing ”, 48th Edition, Charotar Publishing House, 2005.
4. S. Trymbaka Murthy, “Computer Aided Engineering Drawing ”, I.K. International Publishing House Pvt. Ltd., New Delhi.
5. P. J. Shah, “A Text Book og Engineering Graphics”, S. Chand & Company Ltd., New Delhi
6. Arunoday Kumar, “Engineering Graphics – I and II”, Tech – Max Publication, Pune.
7. T. Jeyapooan, “Engineering Drawing & Graphics using Auro CAD 2000”, Vikas Publishing Hoise Pvt. Ltd. , New Delhi.
8. R. K. Dhawan, “A Text Book of Engineering Drawing”, by S. Chand & Company Ltd., New Delhi.
9. P. S. Gill, “A Text Book of Engineering Drawing”, S K Kataria & sons, Delhi.
10. D. A. Jolhe, “Engineering Drawing with an Introduction to Auto CAD”, D. A. Jolhe Tata McGraw – Hill Publishing Co. Ltd., New Delhi.
11. S. Trymbaka Murthy, “Computer Aided Engineering Drawing ”, I.K. International Publishing House Pvt. Ltd., New Delhi.

NOTE: Examination comprise 30% manual drawing and 70% using software

PROFESSIONAL DEVELOPMENT–I PD236

(Common for all branches)

AIM: *The aim of the course is to develop effective oral and written business and executive communication skills and negotiation strategies of the students and also in the areas of boundary value problems and transform techniques.*

OBJECTIVES

At the end of the course the students would

- Be capable of an acceptable level of oral and written communication.*
- Be able to make effective presentations.*
- Be able to apply negotiation strategies*
- Be able to use technology advancements in communication.*

EXECUTIVE AND BUSINESS COMMUNICATION**PART A – BUSINESS COMMUNICATION****UNIT 1****5 Hours**

Introduction: Role of communication – defining and classifying communication – purpose of communication – process of communication – characteristics of successful communication – importance of communication in management – communication structure in organization – communication in crisis

UNIT 2**5 Hours**

Oral communication: What is oral Communication – principles of successful oral communication – barriers to communication – what is conversation control – reflection and empathy: two sides of effective oral communication – effective listening – non – verbal communication

UNIT 3**9 Hours**

Written communication: Functional English Grammar, Purpose of writing – clarity in writing – Vocabulary – commonly confused and misused words, principles of effective writing – approaching the writing process systematically: The 3X3 writing process for business

communication: Pre writing – Writing – Revising – Specific writing features – coherence – electronic writing process.

UNIT 4**6 Hours**

Business letters and reports: Introduction to business letters – writing routine and persuasive letters – positive and negative messages- writing memos – what is a report purpose, kinds and objectives of reports- writing reports

UNIT 5**6 Hours**

Case method of learning: Understanding the case method of learning – different types of cases – overcoming the difficulties of the case method – reading a case properly (previewing, skimming, reading, scanning) – case analysis approaches (systems, Behavioural, decision, strategy) – analyzing the case – dos and don'ts for case preparation

UNIT 6**8 Hours**

Presentation skills: What is a presentation – elements of presentation – designing a presentation. Advanced visual support for business presentation- types of visual aid

Negotiations skills: What is negotiations – nature and need for negotiation – factors affecting negotiation – stages of negotiation process – negotiation strategies

UNIT 7**6 Hours**

Employment communication: Introduction – writing CVs – Group discussions – interview skills

Impact of Technological Advancement on Business Communication

Communication networks – Intranet – Internet – e mails – SMS – teleconferencing – videoconferencing

PART –B EXECUTIVE COMMUNICATION**UNIT 8****7 Hours**

Group communication: Meetings – Planning meetings – objectives – participants – timing – venue of meetings – leading meetings.

Media management – the press release- press conference – media interviews

Seminars – workshop – conferences.

Business etiquettes.

UNIT 9**8 Hours**

Harnessing Potential & Developing Competencies in the areas of : Leadership Skills, Body Language, Phonetics, Stress, Rhythm, Voice & Intonation, Eye Contact, Understanding Personal Space, Team Building, Motivational Skills, Assertiveness Communication Skills, Active Listening, Lateral & Creative Thinking, Cross Cultural Communication, Conflict Resolution, Time Management, Stress Management, Selling Skills & Customer Relationship Management, Appropriate Humour at the Workplace.

RECOMMENDED READINGS:

1. Business Communication : Concepts, Cases And Applications – P D Chaturvedi, Mukesh Chaturvedi Pearson Education, 1/e, 2004 (UNIT 1, 2, 4, 5, & 7)
2. Business Communication, Process And Product – Mary Ellen Guffey – Thomson Learning , 3/E, 2002 (UNIT 3)
3. Basic Business Communication – Lesikar, Flatley TMH 10/E, 2005 (UNIT 1, 2, 4, 5, & 7)
4. Advanced Business Communication – Penrose, Rasberry, Myers Thomson Learning, 4/e, 2002 (UNIT 6 & 8)
5. Business Communication, M.K. Sehgal & V. Khetrapal, Excel Books.
6. Effective Technical Communication By M Ashraf Rizvi .- TMH, 2005
7. Business Communication Today by Bovee Thill Schatzman – Pearson & Education, 7th Ed, , 2003
8. Contemporary Business Communication - Scot Ober-Biztantra, 5/e
9. Business Communication – Krizan, Merrier, Jones- Thomson Learning, 6/e, 2005

HOLISTIC EDUCATION- HE271*(Common for all branches)***PAPER DESCRIPTION:**

This paper contains three units which are Introduction to Life skills, Personal skills, Inter-personal Skills and Societal Skills. This paper aims at enabling the students to various skills in life.

PAPER OBJECTIVE:

- *Holistic development of the individual adult in every student*
- *Knowing life and its principles*
- *Broadening the outlook to life*
- *Training to face the challenges of life*
- *Confidence creation and personality development*
- *Emotional control and stress management*
- *Creating awareness on duties, rights and obligations as member of the Society*
- *Realizing Personal Freedom-its limits and limitations*
- *Developing the attitude to be a contributor and giver*
- *Realizing the real happiness in life*

LEVEL OF KNOWLEDGE: *Basic***1. INTRODUCTION TO LIFE SKILLS (I Semester)****4 Hours****2. PERSONAL SKILLS**

- Creative thinking and Problem solving (I Semester)
- Critical thinking and Decision making(I Semester)
- Study skills and Time management(II Semester)
- Health (II Semester)

3. INTER-PERSONAL SKILLS**4 Hours**

- Non verbal Communication(I Semester)
- Empathy and active listening(I Semester)
- Assertiveness Training (II Semester)
- Conflict Management(II Semester)

4. SOCIETAL SKILLS**4 Hours**

- Human Rights(I Semester)
- Civil Society and Civic sense(I Semester)
- Equality and Justice(II Semester)
- Gender Sensation(II Semester)

ESSENTIAL READING: Holistic Education by Christ College publication, Bangalore-560029

ENGINEERING PHYSICS LABORATORY – PH251

(Common for all branches)

SUBJECT DESCRIPTION:

This paper contains twelve experiments and aims at enabling the students to Practical Engineering Physics.

SUBJECT OBJECTIVES:

- *To develop scientific and experimental skills of the students*
- *To correlate the theoretical principles with application based studies.*

LEVEL OF KNOWLEDGE: *Basic/working***(Any 8 only)**

1. Planck's Constant (Determination of Planck's constant using LED or using the principle of photoelectric effect)
2. Verification of Stefan's law
3. Thermal Conductivity of a bad conductor – Lee's disc apparatus.
4. Determination of Fermi Energy
5. Young's modulus – Non-uniform bending/Strain gauge/Travelling Microscope
6. Measurement of Dielectric Constant(Charging & discharging of capacitor)
7. Interference at a wedge.
8. Laser Diffraction (Determination of grating constant and number of rulings per inch using diffraction grating)
9. Ultrasonic Interferometer.
10. Frequency determination – Melde's apparatus
11. Magnetic properties (B-H Graph Method.....[Demo]
12. Particle size determination – Laser diffraction method.....[Demo]

ESSENTIAL READING:

1. Sathyaseelan H, "Laboratory Manual in Applied Physics", New Age International, 3rd Edition, 2012.
2. B.L.Worsnop and H.T.Flint, Advanced Practical Physics for Students, Methuen and Co., London, 9th Edition, 1957.

RECOMMENDED READING:

1. Engineering Physics Laboratory Manual for the First / Second Semester, Department of Physics, R.V. College of Engineering, 2011.

ELECTRICAL ENGINEERING LABORATORY – EE252**SUBJECT DESCRIPTION:**

This Laboratory contains twelve experiments and aims at enabling the students to learn the concepts of electric circuits, machines, wiring, basic appliances, safety issues etc pertaining to Electrical engineering.

SUBJECT OBJECTIVES:

- *To develop scientific and experimental skills of the students*
- *To correlate the theoretical principles with application based studies.*

LIST OF EXPERIMENTS

1. Familiarization with Electrical Symbols, tools and materials.
2. Verification of Ohm's law.
3. Verification of Kirchhoff's Circuit laws. (KVL, KCL)
4. Two way control of lamp & Fluorescent Lamp
5. Two Way Plus Intermediate Switching Control Of Lamp And Fluorescent Lamp
6. Two Way Plus Intermediate Switching 3-Wire Control Of Lamp And Fluorescent Lamp
7. Measurement Of Single Phase Ac Power using RL Load
8. Measurement Of Power Factor Using Fluorescent Lamp
9. Error Calculations In Single Phase Energy Meter
10. O.C & S.C Tests On 1- ϕ Transformer.

RECOMMENDED READING:

1. Nagasarkar T. K. & Sukhija M. S., "*Basic Electrical Engineering*", OUP 2005
2. Kothari D. P. & Nagarith I. J, "*Basic Electrical Technology*", TMH 2004
3. Rajendra Prasad, "*Fundamentals of Electrical Engineering*", Prentice Hall of India Pvt. Ltd., 2005

SEMESTER III**MATHEMATICS - III ME331 (MA 1202)****Paper Description:**

This paper contains five units which are Fourier Series, Fourier Transform, Partial Differential Equation, Numerical Analysis and Calculus of Variation. This paper enables the students a solid foundation upon the fundamental theorems and application of different transformations. It also help the students to have an in depth knowledge of various advanced numerical methods and interpolation techniques. Different methods to solve a partial differential equation and calculus of variation are also covered in this paper.

Paper objective:

The course aims to develop the skills of the students in the areas of all engineering. This will be necessary for their effective studies in a large number of engineering subjects.

UNIT – I: Fourier Series**12 Hours**

Periodic functions, Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine and cosine series – Complex form of Fourier Series – Harmonic Analysis.

UNIT – II: Fourier Transform**12 Hours**

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Transform of the derivative and the derivative of the transform - Convolution theorem – Parseval's identity.

UNIT-III: Partial Differential Equations**13 Hours**

Formation of PDE, Solution of homogeneous PDE involving derivative with respect to one independent variable only (Both types with given set of conditions), solution of non-homogeneous PDE by direct integration, Method of separation of variables. (First and second order equations) Solution of Lagrange's linear PDE of the type $Pp + Qq = R$

Derivation of one dimensional wave and heat equations. Various possible solutions of these by the method of separation of variables. D'Alembert's solution of wave equation. Two dimensional

Laplace's equation – various possible solutions. Solution of all these equations with specified boundary conditions. (Boundary value problems) Christ University Faculty of Engineering

UNIT-IV: Numerical Methods – I**12 Hours**

Numerical solutions of algebraic and transcendental equations by Newton - Raphson and Regula - Falsi methods. Solution of linear simultaneous equations: - Gauss elimination and Gauss Jordan methods. Gauss – Seidel iterative method. Computation of largest eigen value and the corresponding eigenvector by Rayleigh's power method.

Finite differences (Forward and Backward differences) Interpolation, Newton's forward and backward interpolation formulae. Divided differences – Newton's divided difference formula. Lagrange's interpolation and inverse interpolation formulae.

UNIT-V: Calculus of Variations**11 Hours**

Variation of a function, Variational problems, Euler's equation and its solution, Standard variation problems including geodesics, minimal surface of revolution, hanging chain and Brachistochrone problems. Functional, functionals involving higher order derivatives.

ESSENTIAL READING:

1. Dr. B. S. Grewal, "Higher Engineering Mathematics", 39th Edition, Khanna Publishers, July 2005.

RECOMMENDED READING:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc. 2005.
2. B.V. Ramana, "Higher Engineering Mathematics", Tata-Macgraw Hill, 2009
3. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education.
4. S. C. Malik, Savita Arora, "Mathematical Analysis", 2nd Edition, New Age International (P) Ltd., 2002.
5. George F. Simmons and Steven G. Krantz, "Differential Equation, Theory, Technique and Practice", Tata McGraw – Hill, 2006.
6. M. D. Raisinghania, "Ordinary and Partial Differential Equation", Chand (S.) & Co. Ltd., India, March 17, 2005
7. H. K. Das & Rajnish Verma, "Higher Engineering Mathematics", S. Chand & Company Ltd., 2011.

ME332 MATERIAL SCIENCE AND METALLURGY

Paper Description: *Provides basic knowledge about engineering materials and metallurgy.*

Paper Objectives:

- *At the heart of materials science is an understanding of the micro structure of solids.*
- *Micro structure" is used broadly in reference to solids viewed at the subatomic (electronic) and atomic levels, and the nature of the defects at these levels.*
- *To study the micro structures of solids at various levels, especially the defects, which influences the mechanical, electronic, chemical, and biological properties of solids.*
- *To comprehend phenomenological and mechanistic relationships between the microstructure and the macroscopic properties of solids , in essence, what the materials science is all about.*

Level of knowledge: *Basic.*

LEARNING OUTCOMES:

- *Will be able to select material for engineering applications.*
- *Will be able to identify the material structures and determine its properties based on its structures.*
- *Will have the knowledge of sub atomic and atomic structure of materials.*
- *Will be able to able to analyze the mechanical behavior of materials.*

UNIT-1**12 Hours.**

Crystal Structure: BCC, FCC and HCP Structures, coordination number and atomic packing factors, crystal imperfections -point line and surface imperfections. Atomic Diffusion: Phenomenon, Fick's laws of diffusion, factors affecting diffusion.

Mechanical Behaviour: Stress-strain diagram showing ductile and brittle behaviour of materials, linear and non linear elastic behaviour and properties, mechanical properties in plastic range, yield strength offset yield strength, ductility, ultimate tensile strength, toughness. Plastic deformation of single crystal by slip and twinning.

UNIT – 2**12 Hours****Fracture:** Type I, Type II and Type III.**Creep:** Description of the phenomenon with examples. three stages of creep, creep properties, stress relaxation.**Fatigue:** Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, fatigue testing and SN diagram.**UNIT – 3****12 Hours.****Solidification:** Mechanism of solidification, Homogenous and Hetrogeneous nucleation, crystal growth, cast metal structures.**Phase Diagram I:** Solid solutions Hume Rothary rule substitutional, and interstitial solid solutions, intermediate phases, Gibbs phase rule.**UNIT – 4****12 Hours.****Phase Diagram II:** Construction of equilibrium diagrams involving complete and partial solubility, lever rule. Iron carbon equilibrium diagram description of phases, solidification of steels and cast irons, invariant reactions.**Heat treating of metals:** TTT curves, continous cooling curves, annealing and its types. normalizing, hardening, tempering, martempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding, flarne hardening and induction hardening, age hardening of aluminium-copper alloys.**UNIT -5****12 Hours.****Ferrous and non ferrous materials:** Properties, Compostion and uses of

- Grey cast iron, malleable iron, S.G iron and steel
- Copper alloys-brasses and bronzes Aluminium alloys-Al-Cu,Al-Si,Al-Zn alloys.

Composite Materials: Definition, classification, types of matrix materials & reinforcements, fundamentals of production of FRP' sand MMC's advantages and application of composites.

ESSENTIAL READING:

3. Foundations of Materials Science and Engineering, Smith, 3rd Edition McGraw Hill, 2009
4. Materials Science, Shackelford., & M. K. Muralidhara, Pearson Publication – 2007.

RECOMMENDED READING:

1. An introduction to Metallurgy; Alan Cottrell, University Press India Oriental Longman Pvt. Ltd., 1974.
2. Engineering Materials Science, W.C.Richards, PHI, 1965
3. Physical Metallurgy; Lakhtin, Mir Publications
4. Materials Science and Engineering, V.Raghavan , PHI, 2002
5. Elements of Materials Science and Engineering, H. VanVlack, Addison- Wesley Edn., 1998
6. Materials Science and Engineering, William D. Callister Jr., John Wiley & Sons. Inc, 5th Edition, 2001.
7. The Science and Engineering of Materials, Donald R. Asklund and Pradeep.P. Phule, Thompson Learning, 4th Ed., 2003.

ME333 BASIC THERMODYNAMICS

Paper Description: *Provides basic knowledge of thermal engineering.*

Paper Objectives:

Thermodynamics is a basic science that deals with energy and energy changes. This course covers the basic principles of Thermodynamics and presents real-world applications and problems so that students can gain an understanding of physical and chemical changes that are influenced by the energy of systems.

Level of Learning: *Basic.*

LEARNING OUTCOME:

- *To explain energy conservation principle*
- *To balance different forms energies associated in a process*
- *To be able to analyse the conversion of heat in to work*
- *To be able to describe the direction and possibility of a process*
- *To be able to calculate the efficiency of device which converts heat into work and visa-versa*
- *To be able to define and describe entropy and entropy increase principle*
- *To be able to differentiate real and ideal gas*

UNIT –1**12 Hours**

Fndamental Concepts & Definitions: Thermodynamis; definition and scope, Microscopic and Macroscopic approaches. Engineering thermodynamics; definition, some practical applications of engineering thermodynamic. System (Closed system) and Control Volume (open system); Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive and extensive properties. Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic preesses; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium, Zeroth law of thermodynamics, Temperature; concepts, scales, measurement. Internal fixed points.

UNIT – 2**13 Hours**

Work and Heat: Mechancis, defintion of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; at part of a system boundary, at whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work. Heat; definition, units and sign convention, what heat is not.

First Law of Thermodynamics: Joules expriments, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law to non - cyclic processes, energy, energy as a property, modes of energy, pure substance; definition, two-property rule, Specific heat at constant volume, enthalpy, specific heat constant pressure. Extension of the First law to control volume; steady state-steady flow energy equation, important applications, analysis of unsteady processes such as filmg and evacuation of vessels with and without heat transfer.

UNIT – 3**11 Hours**

Second Law of Thermodynamics: Devices converting heat to work; (a) in a thermodynamic cycle, (b) in a mechanical cycle. Thermal reservoir. Direct heat engine; schematic representation and efficiency. Devices converting work to heat in a thermodynamic cycle; reserved heat engine, schematic representation, coefficients of performace. Keivin - Planck statement of the Secnd law of Thermodynamics; PMM II and PMM I, Clsius statement of Second law of Thermodynamics, Equivalence of the two statements; Reversible and irrevesible processes; factors that make a process irreversible, reversible heat engines, Carnot cycle, Carnot principles. Thermodynamic temperature scale.

UNIT – 4**13 Hours**

Entropy: Clsius inequality; Statement, proof, application to a reversible cycle. Entropy; definition, a property, principle of increase of entropy, entropy as a quantitative test for irreversibility, calculation of entropy using Tds relations, entropy as a coordinate. Available and unavailable energy.

Pure Substances: P-T and P-V diagrams, triple point and critical points. Sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapour, saturated vapour and superheated vapour states of pure substance with water as example. Enthalpy of change of phase (Latent heat). Dryness

fraction (quality), T-S and H-S diagrams, representation of various processes on these diagrams. Steam tables and its use. Throttling calorimeter, separating and throttling calorimeter.

UNIT – 5

Thermodynamic relations: Maxwell relation, Clausius Clapeyron's equation. Ideal gas; equation of state, internal energy and enthalpy as functions of temperature only, universal and particular gas constants, specific heats, perfect and semi-perfect gases. Evaluation of heat, work, change in internal energy. enthalpy and entropy in various quasi-static processes.

Ideal gas mixture : Ideal gas mixture; Dalton's laws of partial pressures, Amagat's law of additive volumes, evaluation of properties, Analysis of various process. Real Gases: Introduction. Vander Waal's Equation of state, Vander Waal's constants in terms of critical properties, law of corresponding states, compressibility factor; compressibility chart

ESSENTIAL READINGS:

1. Basic and applied thermodynamics, p.k.nag, tata mcgraw hll pub. 2002
2. Thermodynamics, an engineering approach, yunus a.cengel and michael a.boles, tata mcgraw hill publications, 2002

RECOMMENDED READING:

1. K.A.Venkatesh Basic Engineering Thermodynamics, Thermodynamic data hand book by B.T. Nijaguna. (To be supplied in the examination)
2. Engineering Thermodynamics, J.B.Jones and G.A.Hawkins, John Wiley and Sons..
3. Fundamentals of Classical Thermodynamics, G.J.Van Wylen and R.E.Sonntag, Wiley Eastern.
4. An Introduction to Thermodynamics, Y.V.C.Rao, Wiley Eastern, 1993,
5. B.K Venkanna "Basic Thermodynamics, PHI New Delhi

ME334 MECHANICS OF MATERIALS

PAPER DESCRIPTION: *provides basic knowledge about forces acting on bodies.*

PAPER OBJECTIVE:

- 1. *The first objective of this course is to study the relationships between the external loads applied to deformable body and the intensity of internal forces or stresses acting within the body. it also involves the study of deformations or strains caused by external loads. based on linear elastic material behavior you will be given sufficient*
- 2. *Understanding of the relationships between stress and strain in two and three dimensions.*
- 3. *Understanding the yield criteria for static loading, fatigue and fracture under repetitive loading will be covered to enable students design structures, machines and components.*
- *level of knowledge: basic.*

UNIT 1:**13 Hours**

Simple Stress and Strain: Introduction, Stress, strain, mechanical properties of materials, Linear elasticity, Hooke's Law and Poisson's ratio, Stress-Strain relation - behavior in tension for Mild steel, cast iron and non ferrous metals. Extension / Shortening of a bar, bars with cross sections varying in steps, bars with continuously varying cross sections (circular and rectangular), Elongation due to self weight, Principle of super position.

Stress in Composite Section: Volumetric strain, expression for volumetric strain, elastic constants, simple shear stress, shear strain, temperature stresses (including compound bars).

UNIT 2:**12Hours**

Compound Stresses: Introduction, Plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress.

Energy Methods: Work and strain energy, Strain energy in bar/beams, castiglianos theorem, Energy methods.

Thick and Thin Cylinder Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume). Thick cylinders Lamé's equation (compound cylinders not included).

UNIT 3:**11 Hours**

Bending Moment and Shear Force in Beams: Introduction, Types of beams, loads and reactions, shear forces and bending moments, rate of loading, sign conventions, relationship between shear force and bending moments. Shear force and bending moment diagrams for different beams subjected to concentrated loads, uniformly distributed load, (UDL) uniformly varying load (UVL) and couple for different types of beams.

UNIT 4:

11Hours Bending and Shear Stresses in Beams: Introduction, Theory of simple bending, assumptions in simple bending. Bending stress equation, relationship between bending stress, radius of curvature, relationship between bending moment and radius of curvature. Moment carrying capacity of a section. Shearing stresses in beams, shear stress across rectangular, circular, symmetrical I and T sections. (Composite / fletched beams not included).

UNIT 5:**13 Hours**

Deflection of Beams: Introduction, Differential equation for deflection. Equations for deflection, slope and bending moment. Double integration method for cantilever and simply supported beams for point load, UDL, UVL and Couple. Macaulay's method

Torsion of Circular Shafts and Elastic Stability of Columns: Introduction. Pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts. Power transmitted by solid and hollow circular shafts

Columns: Euler's theory for axially loaded elastic long columns. Derivation of Euler's load for various end conditions, limitations of Euler's theory, Rankine's formula.

ESSENTIAL READING:

1. "Mechanics of materials", by R.C.hibbeler, printice hall. pearson edu., 2005
2. "Mechanics of materials", James.m.gere, thomson, fifth edition 2004.
3. "Mechanics of materials", in S.I. units, ferdinand beer & russell johnstan, tata mcgrawhill- 2003.

RECOMMENDED READING:

1. S.S. Rattan, "Strength of Materials", Tata McGraw Hill, 2009
2. S.S.Bhavikatti, "Strength of Materials", Vikas publications House -1 Pvt. Ltd., 2nd Ed., 2006.
3. " K.V. Rao, G.C. Raju, Mechanics of Materials", First Edition, 2007
4. "Engineering Mechanics of Solids", Egor.P. Popov, Pearson Edu. India, 2nd, Edison, 1998.
5. ", W.A. Nash, Strength of Materials Sehaum's Outline Series, Fourth Edition-2007.
- 6 Rajput.R.K. "Strength of Materials" S.Chand & co Ltd. New Delhi 1996
- 7 Bansal, R.K, Strength of Materials, Lakshmi Publication (P) Ltd, New Delhi.

ME335 MANUFACTURING PROCESS-I

Paper Description: *Provides knowledge about primary manufacturing techniques.*

Paper Objective:

The objective of studying Manufacturing process program is to provide students with an understanding of specific advanced and emerging manufacturing technologies and skills relating to the implementation of these technologies in modern industry within both global and local contexts. It is expected that graduates will be sufficiently competent to direct the design and implementation of specific technologies and/or processes addressed during the course in the context of a particular organization.

Level of knowledge: *Theoretical.*

LEARNING OUTCOME:

- *Will be able to describe the various casting process and can build his career in foundry.*
- *Will be able to explain the Special types of welding process, and will apply for fabrication which require welding.*
- *Will be able to explain the Different Types of Soldering & Brazing Methods.*
- *Will be able to describe the Flame characteristics of welding process.*

UNIT 1**Casting process:**

Introduction: Concept of Manufacturing process, its importance. Classification of Manufacturing processes. Introduction to Casting process & steps involved. Varieties of components produced by casting process. Advantages & Limitations of casting process.

Patterns: Definition, functions, Materials used for pattern, various pattern allowances and their importance. Classification of patterns, BIS colour coding of Patterns.

Binder: Definition, Types of binder used in moulding sand.

Additives: Need, Types of additives used.

UNIT 2

Sand Moulding : Types of base sand, requirement of base sand. Moulding sand mixture ingredients (base sand, binder & additives) for different sand mixtures. Method used for sand moulding, such as Green sand, dry sand and skin dried moulds.

Cores: Definition, Need, Types. Method of making cores, Binders used, core sand moulding.

Concept of Gating & Riserling. Principle and types.

Fettling and cleaning of castings. Basic steps, Casting defects, Causes, features and remedies.

Moulding Machines : Jolt type, Squeeze type, Jolt & Squeeze type and Sand slinger.

UNIT 3:

Special moulding Process: Study of important moulding processes, No bake moulds, Flaskless moulds, Sweep mould, CO₂ mould, Shell mould, Investment mould.

Metal moulds: Gravity die-casting, Pressure die casting, Centrifugal casting, Squeeze Casting, Slush casting, Thixocasting and Continuous Casting Processes.

Melting Furnaces: Classification of furnaces. Constructional features & working principle of coke fired, oil fired and Gas fired pit furnace, Resistance furnace, Coreless Induction furnace, Electric Arc Furnace, Cupola furnace.

UNIT 4**Welding**

Welding process: Definition, Principles, Classification, Application, Advantages & limitations of welding.

Arc Welding: Principle, Metal Arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding) (SAW) and Atomic Hydrogen Welding processes. (AHW)

Gas Welding: Principle, Oxy – Acetylene welding, Chemical Reaction in Gas welding, Flame characteristics. Gas torch construction & working. Forward and backward welding.

Special types of welding: Resistance welding - principles, Seam welding, Butt welding, Spot welding and projection welding.

Friction welding, Explosive welding, Thermit welding, Laser welding and Electron beam welding.

UNIT 5:

Metallurgical aspect, in welding : Structure of welds, Formation of different zones during welding. Heat affected zone (HAZ). Parameters affecting HAZ. Effect of carbon content on structure and properties of steel. Shrinkage in welds & Residual stresses.

Concept of electrodes, Filler rod and fluxes. Welding defects – Detection causes & remedy.

Principles of soldering & brazing: Parameters involved & Mechanism. Different Types of Soldering & Brazing Methods.

Inspection Methods – Methods used for Inspection of casting and welding. Visual, Magnetic particle, Fluorescent particle, Ultrasonic, Radiography, Eddy current, Holography methods of Inspection.

ESSENTIAL READING

1. Dr.K.Radhakrishna, “Manufacturing Process-I”, Sapna Book House, 5th Revised Edition 2009.
2. P.N.Rao Manufacturing & Technology: Foundry Forming and Welding 2nd Ed., Tata McGraw Hill, 2003.

RECOMMENDED READING:

1. Serope Kalpakjain, Steuen.R.Sechmid, “Manufacturing Technology”, Pearson Education Asia, 5th Ed. 2006.
2. Roy A Lindberg, “Process and Materials of Manufacturing”, 4th Ed. Pearson Edu. 2006.

ME336 PROFESSIONAL DEVELOPMENT**Paper description**

The aim of the course is to develop effective oral and written business and executive communication skills, negotiation strategies of the students, inputs into problems and transformational techniques and also to provide insight into Principles of Management.

Paper objectives

At the end of the course the students would

- Be capable of an acceptable level of oral and written communication.*
- Be able to make effective presentations.*
- Be able to apply negotiation strategies and understand Principles of management*
- Be able to use technology advancements in communication.*

LEARNING OUTCOME:

- Able to communicate orally and will have excellent written communication skills.*
- Will have excellent presentation skills*
- Will have excellent management capabilities and negotiation skills.*
- Adopts the use of technological advancement in communication.*

**EXECUTIVE AND BUSINESS COMMUNICATION AND PRINCIPLES OF
MANAGEMENT****Part A – Business communication****MODULE 1****4 Hours**

Introduction: Role of communication – defining and classifying communication – purpose of communication – process of communication – characteristics of successful communication – importance of communication in management – communication structure in organization – communication in crisis

MODULE 2**4 Hours**

Oral communication: What is oral Communication – principles of successful oral communication – barriers to communication – what is conversation control – reflection and empathy: two sides of effective oral communication – effective listening – non – verbal communication

MODULE 3**8 Hours**

Written communication: Functional English Grammar, Purpose of writing – clarity in writing – Vocabulary – commonly confused and misused words, principles of effective writing – approaching the writing process systematically: The 3X3 writing process for business communication: Pre writing – Writing – Revising – Specific writing features – coherence – electronic writing process.

MODULE 4**5 Hours**

Business letters and reports: Introduction to business letters – writing routine and persuasive letters – positive and negative messages- writing memos – what is a report purpose, kinds and objectives of reports- writing reports

MODULE 5**4 Hours**

Case method of learning: Understanding the case method of learning – different types of cases – overcoming the difficulties of the case method – reading a case properly (previewing, skimming, reading, scanning) – case analysis approaches (systems, Behavioural, decision, strategy) – analyzing the case – dos and don'ts for case preparation

MODULE 6**8 Hours**

Presentation skills: What is a presentation – elements of presentation – designing a presentation. Advanced visual support for business presentation- types of visual aid

Negotiations skills: What is negotiations – nature and need for negotiation – factors affecting negotiation – stages of negotiation process – negotiation strategies

MODULE 7**6 Hours**

Employment communication: Introduction – writing CVs – Group discussions – interview skills-Impact of Technological Advancement on Business Communication,Communication networks – Intranet – Internet – e mails – SMS – teleconferencing – videoconferencing

Part –B Executive communication**MODULE 8****7 Hours**

Group communication: Meetings – Planning meetings – objectives – participants – timing – venue of meetings – leading meetings.

Media management – the press release- press conference – media interviews

Seminars – workshop – conferences.

Business etiquettes.

MODULE 9**8 Hours**

Harnessing Potential & Developing Competencies in the areas of : Leadership Skills, Body Language, Phonetics, Stress, Rhythm, Voice & Intonation, Eye Contact, Understanding Personal Space, Team Building, Motivational Skills, Assertiveness Communication Skills, Active Listening, Lateral & Creative Thinking, Cross Cultural Communication, Conflict Resolution, Time Management, Stress Management, Selling Skills & Customer Relationship Management, Appropriate Humour at the Workplace.

RECOMMENDED READING:

1. Business Communication : Concepts, Cases And Applications – P D Chaturvedi, Mukesh Chaturvedi Pearson Education, 1/e, 2004 (Module 1, 2, 4, 5, & 7)
2. Business Communication, Process And Product – Mary Ellen Guffey – Thomson Learning , 3/E, 2002 (Module 3)
3. Basic Business Communication – Lesikar, Flatley TMH 10/E, 2005 (Module 1, 2, 4, 5, & 7)
4. Advanced Business Communication – Penrose, Rasberry, Myers Thomson Learning, 4/e, 2002 (Module 6 & 8)
5. Business Communication, M.K. Sehgal & V. Khetrapal, Excel Books.
6. Effective Technical Communication By M Ashraf Rizvi .- TMH, 2005
7. Business Communication Today by Bovee Thill Schatzman – Pearson & Education, 7th Ed, , 2003
8. Contemporary Business Communication - Scot Ober-Biztantra, 5/e
9. Business Communication – Krizan, Merrier, Jones- Thomson Learning, 6/e, 2005

Part – C Principles of management**MODULE 10****(6 Hours)**

Management: Introduction: Definition of management, nature, purpose and functions, level and types of managers, Manager/Non-Manager, Managerial Roles, Essential Managerial Skills, Key personal characteristics for Managerial success. Evolution and various schools to management thoughts, continuing management themes – quality and performance excellence, global awareness, learning organization, Characteristics of 21st century Executives. Social responsibility of managers.

RECOMMENDED READING:

1. Management– J.R. Schermerhorn Jr. Wiley India, New Delhi 2004.
2. Management-Concepts and Cases-V.S.P.Rao, Excel Books
3. Management - A Global and Entrepreneurial Perspective - Harold Koontz, Heinz Weihrich - TMH 12th edition, 2008.

ME351 METALLOGRAPHY & MATERIAL TESTING LABORATORY

PAPER DESCRIPTION: *Provides working knowledge of material properties and testing skills.*

PAPER OBJECTIVE:

To develop skills in the field of material science.

- *Verify the principles of the course*
- *Application of the theory , Understanding of fundamentals of the subject.*
- *Be in a position to relate theory and practice, Level of knowledge: Working.*

SUBJECT DESCRIPTION:

This Laboratory has various experiments that aims at enabling the students to learn the concepts of Material testing and metallographic analysis of specimens.

LEARNING OUTCOME:

- *Will be able to identify materials of engineering importance, appreciate its application in various engineering application.*
- *Will be able to test different materials for various mechanical properties.*
- *Will be able to carry out metallographic tests.*
- *To develop scientific, technical and experimental skills to the students.*
- *To correlate the theoretical principles with application based studies.*

PART – A

1. Preparation of specimen for Metallographic examination of different engineering materials. Identification of microstructures of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze & composites.
2. Heat treatment: Annealing, normalizing, hardening and tempering of steel. Hardness studies of heat-treated samples.
3. To study the wear characteristics of ferrous, non-ferrous and composite materials for different parameters.
4. Non-destructive test experiments like,

- (a). Ultrasonic flaw detection
- (b). Magnetic crack detection
- (c). Dye penetration testing. To study the defects of Cast and Welded specimens

PART – B

1. Tensile, shear and compression tests of metallic and non metallic specimens using Universal Testing Machine
2. Torsion Test
3. Bending Test on metallic and nonmetallic specimens.
4. Izod and Charpy Tests on M.S,C.I Specimen.
5. Brinell, Rockwell and Vickers's Hardness test.
6. Fatigue Test.

ME352 FOUNDRY & FORGING LABORATORY**PAPER DESCRIPTION:**

Provides working knowledge on preparation of moulds, forging models and sand testing.

PAPER OBJECTIVES:

- *Preparation of casting models, gating system design, die / pattern design and mechanization of foundry.*
- *Aim is to provide insight of the subject.*
- *Sensitizes the students of the importance of course in real life environment.*

SUBJECT DESCRIPTION:

This Laboratory has various experiments that aims at enabling the students to learn the concepts of Foundry and Forging.

OUTCOME:

- *Will have learnt the skill of developing the different types of moulds.*
- *Use of patterns.*
- *Preparing fasteners and mechanical elements through forging process.*
- *To develop scientific ,technical and experimental skills to the students*
- *To correlate the theoretical principles with application based studies.*

LEVEL OF KNOWLEDGE: *Working.*

PART – A**• Testing of Moulding sand and Core sand**

Preparation of sand specimens and conduction of the following tests:

1. Compression, Shear and Tensile tests on Universal Sand Testing Machine.
2. Permeability test
3. Core hardness & Mould hardness tests.
4. Sieve Analysis to find Grain Finest number of Base Sand
5. Clay content determination in Base Sand

PART – B**• Foundry Practice**

1. Use of foundry tools and other equipments.
2. Preparation of moulds using two moulding boxes using patterns or without patterns.
(Split pattern, Match plate pattern and Core boxes).
3. Preparation of one casting (Aluminum or cast iron-Demonstration only)

PART – C**• Forging Operations**

1. Calculation of length of the raw material required to do the model.
2. Preparing minimum three forged models involving upsetting, drawing and bending operations.
3. Out of these three models, at least one model is to be prepared by using Power Hammer.

SEMESTER IV**ME431 MATHEMATICS IV (MA1253)**

Paper description: *This paper contains five units which are Numerical Methods, Complex Variables, Series Solution of Differential Equation and Special Function with Statistics and Probability. This paper emphasizes the basic concepts and methods of probability, discrete and continuous random variables are considered.*

Paper objective: *The course aims to develop the skills of the students in the areas of all engineering. This will be necessary for their effective studies in a large number of engineering subjects and able to apply and solve problems arising in applications. The course will also serve as a prerequisite for post graduate and specialized studies and research.*

Level of knowledge: *Basic*

UNIT- I**7 Hours****Numerical methods-ii:**

Numerical solutions of first order and first degree ordinary differential equations – Taylor’s series method, Modified Euler’s method, Runge–Kutta method of fourth order, Milne’s and Adams-Bash forth predictor and corrector methods (All formulae without Proof).

UNIT- II**15 Hours****Complex variables:**

Function of a complex variable, Limit, Continuity Differentiability – Definitions. Analytic functions, Cauchy – Riemann equations in Cartesian and polar forms, Properties of analytic functions. Conformal transformation – Definition. Discussion of transformations:

$W = z^2$, $W = e^z$, $W = z + \frac{1}{z}$, Bilinear transformations. Complex line integrals, Cauchy’s

theorem, Cauchy’s integral formula. Taylor’s and Laurent’s series (Statements only) Singularities, Poles, Residues, Cauchy’s residue theorem (statement only)

UNIT- III**8 Hours****Series solution of ordinary differential equations and special functions:**

Series solution – Frobenius method, Series solution of Bessel's D.E. leading to Bessel function of first kind. Equations reducible to Bessel's D.E., Series solution of Legendre's D.E. leading to Legendre Polynomials. Rodrigue's formula

UNIT- IV**18 Hours****Probability & theoretical distributions:**

Probability–Addition rule, conditional probability, multiplication rule, Bayes' theorem.

Random variables – Discrete and continuous random variables. Probability mass function (pmf), Probability density function (pdf), cumulative distribution function (cdf), mean, variance, joint probability distribution, Independent random variables. Expectation, Covariance, Correlation coefficient

Theoretical distribution - Binomial, Poisson, Normal and Exponential distributions

UNIT-V**Statistical methods:**

Curve fitting by the method of least squares: $y = a + bx$, $y = a + bx + cx^2$, $y = ax^b$, $y = ab^x$, $y = ae^{bx}$, Correlation and Regression

Sampling, Sampling distribution, Standard error. Testing of hypothesis for means. Confidence limits for means, Student's t distribution, Chi-square distribution as a test of goodness of fit.

ESSENTIAL READING:

1. Dr. B. S. Grewal, "Higher Engineering Mathematics", 39th Edition, Khanna Publishers, July 2005.
2. Murray R. Spiegel, John Schiller, R. Alu Srinivasan, "Theory and Problems of Probability and Statistics", Schaum's series, Tata-Macgraw Hill, 2004.

RECOMMENDED READING:

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, 8th Edition, John Wiley & Sons, Inc.
2. B.V. Ramana, “Higher Engineering Mathematics”, Tata-Macgraw Hill
3. Glyn James, “Advanced Modern Engineering Mathematics”, Pearson Education.
4. Sheldon M. Ross, “Introduction to Probability Models”, 9th Edition, Academic Press, 2008

ME432 APPLIED THERMODYNAMICS

PAPER DESCRIPTION: *Provides advanced knowledge about applications of thermodynamics in the field of mechanical engineering.*

PAPER OBJECTIVE:

To make the students understand thermodynamic principles, compressible flow and fundamentals of heat transfer with its concepts in the operation of automotive engines. Specifically, students will have the ability to apply the first and second law of thermodynamics to

- (1) vapor power and refrigeration systems,*
- (2) gas power systems,*
- (3) applications concerning humidification, dehumidification, evaporative cooling, and*
- (4) thermodynamics of combustion systems such as furnaces, flow reactors etc.*

LEVEL OF KNOWLEDGE: *Basic of Thermodynamics*

LEARNING OUTCOME:

- *To demonstrate the principle of energy conversion.*
- *To do calculations on Quantity of energy conversion into useful work.*
- *To build real time models based on energy conversion principles.*
- *To judge a certain process can practically possible or not.*
- *To validate a process based on entropy principle.*

UNIT 1:**12 Hours.**

Combustion thermodynamics: Theoretical (Stoichiometric) air for combustion of fuels. Excess air, mass balance, actual combustion. Exhaust gas analysis. A./ F ratio, Energy balance for a chemical reaction, enthalpy of formation, enthalpy and internal energy of combustion, Combustion efficiency

I.C.Engine: Testing of two stroke and four stroke SI and CI engines for performance Related numerical problems, heat balance , Morse test.

UNIT 2:**13 Hours.**

Gas power cycle: Air Standard cycles: Carnot, Otto, Diesel, Dual and Stirling cycles, P-V and T-S diagrams, description, efficiencies and mean effective pressures, Comparison of Otto and Diesel cycles.

Vapour Power Cycles: Carnot vapour power cycles, drawbacks as a reference cycle, Simple Rankine cycle, description, T- S diagram, analysis for performance , comparison of Carnot and Rankine cycles. Effects of pressure and temperature on Rankine cycle performance. Actual vapour power cycles. Ideal and practical regenerative Rankine cycle, open and closed feed water heaters, Reheat Rankine cycle.

UNIT3:**13hours.**

Reciprocating Compressors: Operation of a single stage reciprocating compressors, work input through P-V diagram and steady state steady flow analysis. Effect of clearance and volumetric efficiency. Adiabatic, isothermal and mechanical efficiencies. Multistage compressor, saving in work, optimum intermediate pressure, inter- cooling, minimum work for compression.

Gas turbine and Jet propulsion: Classification of Gas turbines, Analysis of open cycle gas turbine cycle. Advantages and disadvantages of closed cycle. Methods to improve thermal efficiency, Jet propulsion and Rocket propulsion.

UNIT 4:**11 Hours.**

Refrigeration: Vapour compression refrigeration system ; description, analysis, refrigerating effect, capacity , power required, units of refrigeration, COP , Refrigerants and their desirable properties. Air cycle refrigeration; reversed Carnot cycle, reversed Brayton cycle, Vapour absorption refrigeration system, steam jet refrigeration.

UNIT 5:**11 Hours.**

Psychrometry: Atmospheric air and psychrometric properties; Dry bulb temperature, wet bulb temperature, dew point temperature; partial pressures, specific and relative humidities and the relation between the two enthalpy and adiabatic saturation temperature. Construction and use

of psychrometric chart . Analysis of various processes; heating, cooling , dehumidifying and humidifying. Adiabatic mixing of moist air. Summer and winter air conditioning.

Note: Thermodynamics data hand book, B.T.Nijaguna (to be supplied in the examination)

1. A copy of Psychrometry chart to be given along with answer book to the candidates (if needed)

ESSENTIAL READING

1. P.K. Nag Basic and applied Thermodynamics, , Tata Mc Graw Hill Pub.Co,2002
2. Applied Thermodynamics, Rajput, Laxmi Publication
3. B.K. Venkahna Applied Thermodynamics, , PHI, New Delhi

RECOMMENDED READING

- 1 Thermodynamics , An engineering approach, Yunus, A. Cengel and Michael A.Boies, Tata Me Graw Hill pub. Co., 2002,
- 2 Fundamental of Classical Thermodynamics, G.J. Van Wylen and R.E. Sontang Wiley eastern.
- 3 B.K Venkanna “Applied Thermodynamics”, , PHI New Delhi

ME433 KINEMATICS OF MACHINES

Paper Description: *Provides basic Knowledge of various mechanisms and forces acting on.*

PAPER OBJECTIVE:

- *The overall objective of this course is to learn how to analyze the motions of mechanisms, design mechanisms to have given motions, and analyze forces in machines. This includes relative motion analysis and design of gears, gear trains, cams, and linkages, simultaneous graphical and analytical analysis of position, velocity, and acceleration, considering static and inertial forces.*
- *This course reviews and reinforces the student's understanding of Kinematics and the Dynamics of multi body systems with immediate application to the study of machines.*

LEVEL OF UNDERSTANDING: *Basic.*

LEARNING OUTCOME:

- *Familiarity with common mechanisms used in machines and everyday life.*
- *Ability to calculate mobility (number of degrees-of-freedom) and enumerate rigid links and types of joints within mechanisms.*
- *Ability to conduct a complete (translational and rotational) mechanism position analysis.*
- *Ability to conduct a complete (translational and rotational) mechanism velocity analysis.*
- *Ability to conduct a complete (translational and rotational) mechanism acceleration analysis.*
- *Ability to do gear mechanism classification and gear train analysis, and familiarity with gear standardization and specification in design.*
- *Ability to do cam mechanism classification and cam motion profiles, and familiarity with introductory cam design considerations.*

UNIT 1:**13 Hours**

Introduction: Definitions Link or element, kinematic pairs, Degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, Structure, Mobility of Mechanism, Inversion, Machine.

Kinematic Chains and Inversions: Inversions of Four bar chain; Single slider crank chain and Double slider crank chain.

Mechanisms: Quick return motion mechanisms-Drag link mechanism, Whitworth mechanism and Crank and slotted lever Mechanism.

Straight line motion mechanisms Peaucellier's mechanism and Robert's mechanism. Intermittent Motion mechanisms -Geneva wheel mechanism and Ratchet and Pawl mechanism. Toggle mechanism, Pantograph, Ackerman steering gear mechanism.

UNIT 2:

11 Hours.

Velocity and Acceleration Analysis of Mechanisms (Graphical Methods) Velocity and acceleration analysis of Four Bar mechanism, slider crank mechanism and Simple Mechanisms by vector polygons: Relative velocity and acceleration of particles .in a common link, relative velocity and accelerations of coincident Particles on separate links- Coriolis component of acceleration. Angular velocity and angular acceleration of links, velocity of rubbing.

UNIT 3:

12 Hours.

Velocity Analysis by Instantaneous Center Method: Definition, Kennedy's Theorem, Determination of linear and angular velocity using instantaneous center method

Klein's Construction: Analysis of velocity and acceleration of single slider crank mechanism.

Velocity and Acceleration Analysis of Mechanisms (Analytical Methods): Analysis of four bar chain and slider crank chain using analytical expressions. (Use of complex algebra and vector algebra)

UNIT 4:

13 Hours.

Spur Gears: Gear terminology, law of gearing, Characteristics of involute action, Path of contact. Arc of contact, Contact ratio of spur, helical, bevel and worm gears, Interference in involute gears. Methods of avoiding interference, Back lash. Comparison of involute and cycloidal teeth. Profile Modification.

Gear Trains: Simple gear trains, Compound gear trains for large speed. reduction, Epicyclic gear trains, Algebraic and tabular methods of finding velocity ratio of epicyclic gear trains. Tooth load and torque calculations in epicyclic gear trains.

UNIT 5:**11 Hours.**

Cams: Types of cams, Types of followers. Displacement, Velocity and, Acceleration time curves for cam profiles. Disc cam with reciprocating follower having knife-edge, roller and flat-face follower, Disc cam with oscillating roller follower. Follower motions including SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion.

ESSENTIAL READING:

1. Rattan S.S "Theory of Machines", , Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 3rd edition -2009.
2. Sadhu Singh "Theory of Machines", , Pearson Education (Singapore) Pvt. Ltd, Indian Branch New Delhi, 2nd Edi. 2006

RECOMMENDED READING:

1. J.J. Uicker, , G.R. Pennock, J.E. Shigley. "Theory of Machines & Mechanisms", OXFORD 3rd Ed. 2009.
2. Ambakar Mechanism and Machine theory, , PHI Graphical Solutions may be obtained either on the Graph Sheets or on the Answer Book itself.

ME43 4MANUFACTURING PROCESS-II

PAPER DESCRIPTION: *Provides knowledge about various manufacturing techniques.*

PAPER OBJECTIVE:

- *Subject provides students an understanding of basic, advanced and emerging manufacturing technologies. Enables in relating to the implementation of these technologies in modern industry within both global and local contexts.*
- *It makes the graduates sufficiently competent to direct the design and implementation of specific technologies and/or processes addressed during the course in the context of a particular organization.*

LEVEL OF LEARNING: *Basic*

OBJECTIVES:

- *Develop understanding of basis manufacturing processes and capabilities of each.*
- *Extend basis knowledge to solve manufacturing processes related problems.*
- *Develop an understanding of Concurrent Engineering and the importance to manufacturing industries.*
- *Enhance ability to determine what is given and what to find.*
- *Learn to make engineering judgments.*
- *Learn the impact that modern manufacturing techniques have on human advancement.*
- *Understand what manufacturing processes references are available.*
- *Discuss current manufacturing issues.*
- *Emphasize the problem solving process and application techniques.*

LEARNING OUTCOME:

- *Will be able to implement specific advanced and emerging manufacturing technologies in modern industry.*
- *Will be able to describe the process of machining in various types of materials.*
- *Will describe the operations and utilization of lathe, drilling, milling, grinding machine, etc.*
- *Will describe the tool nomenclature, and design the tool for specific operations.*
- *Will apply merchant's analysis for tool wear, failure and life.*

UNIT - 1**13 Hours.**

Theory of Metal Cutting: Single point cutting tool nomenclature, geometry. Mechanics of Chip Formation,Types of Chips. Merchant's circle diagram and analysis, Ernst Merchant's solution, shear angle relationship, problems of Merchant's analysis. Tool Wear and Tool failure, tool life. Effects of cutting parameters on tool life. Tool Failure Criteria, Taylor's Tool Life equation. Problems on tool life evaluation.

UNIT – 2**11 Hours.**

Cutting Tool Materials: Desired properties and types of cutting tool materials – HSS, carbides coated carbides, ceramics. Cutting fluids. Desired properties, types and selection. Heat generation in metal cutting, factors affecting heat generation. Heat distribution in tool and workpiece and chip. Measurement of tool tip temperature.

Turning (Lathe), Shaping and Planing Machines: Classification, constructional features of Turret and Capstan Lathe. Tool Layout, shaping Machine, Planing Machine, Driving mechanisms of lathe, shaping and planing machines, Different operations on lathe, shaping machine and planing machine. Simple problems on machinery time calculations

UNIT-3**13 Hours.**

Drilling machines: Classification, constructional features, drilling & related operations. Types of drill & drill bit nomenclature, drill materials. Introduction to CNC machines- Principles of operation. Axes of NC machine-Coordinate systems. Basics of Manual part programming methods.

Milling machines: Classification, constructional features, milling cutters nomenclature, milling operations, up milling and down milling concepts. Various milling operations.

Indexing: Simple, compound, differential and angular indexing calculations. Simple problems on simple and compound indexing

UNIT - 4:**12 Hours.**

Grinding machines: Types of abrasives,Grain size, bonding process, grade and structure of grinding wheels, grinding wheel types. Classification, constructional features of grinding

machines (Centreless , cylindrical and surface grinding). Selection of grinding wheel. Grinding process parameters. Dressing and truing of grinding wheels.

Broaching process - Principle of broaching. Details of a broach. Types of broaching machines- constructional details. Applications. Advantages and Limitations.

UNIT – 5

11 Hours.

Finishing and other Processes Lapping and Honing operations – Principles, arrangement of set up and application. Super finishing process, polishing, buffing operation and application.

Non-traditional machining processes: Need for non traditional machining, Principle, equipment & operation of Laser Beam, Plasma Arc Machining, Electro Chemical Machining, Ultrasonic Machining, Abrasive Jet Machining, Water Jet Machining, Electron Beam Machining, Electron Discharge Machining and Plasma Arc Machining.

ESSENTIAL READING:

1. Hazara Choudhry, Workshop Technology, Vol-II, Media Promoters & Publishers Pvt. Ltd. 2004
2. R.K.Jain Production Technology, , Khanna Publications, 2003.
3. Production Technology, HMT, Tata MacGraw Hill, 2001.

RECOMMENDED READING:

1. Amitabha Ghosh and Mallik, Manufacturing Science, affiliated East West Press, 2003.
2. G. Boothroyd Fundamentals of Metal Machining and Machine Tools, , McGraw Hill, 2000.

ME435 FLUID MECHANICS

Paper Description: *Provides basic knowledge about fluid at rest and in motion.*

Paper Objectives:

This is a first course in fluid mechanics that involves the study of fluid flow in ducts. The course introduces the fundamental aspects of fluid motion, fluid properties, flow regimes, pressure variations, fluid kinematics, and methods of flow description and analysis. It presents the conservation laws in their integral and differential forms, and their use in analyzing and solving fluid flow problems.

- *Determine distribution in fluids at rest and to calculate hydrostatic forces acting on plane and curved surfaces.*
- *Determine pressure variation in a flowing fluid using Bernoulli's principle.*
- *Determine velocity and acceleration of a fluid at a point.*
- *Apply control volumes to solve fluid flow problems through the application of integral conservation laws of mass, momentum, and energy.*
- *Apply the differential conservation equations of mass, momentum, and energy to fluid flow problems.*
- *Apply basic fluid mechanics principles to the flow of viscous fluids in pipes and ducts.*

Level of knowledge: Basic

UNIT-1**13 Hours.**

Properties of Fluids: Introduction, Properties of fluids, viscosity, thermodynamic properties, surface tension, capillarity, vapour pressure and cavitation

Fluid Statics : Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge, atmospheric and vacuum pressures, simple manometers and differentialmanometers. Total pressure and center of pressure on submerged plane surfaces; horizontal, vertical and inclined plane surfaces, curved surface submerged in liquid.

UNIT-2**11 Hours.****Buoyancy and Fluid Kinematics:**

Buoyancy, center of buoyancy, metacentre and metacentric height, conditions of equilibrium of floating and submerged bodies, determination of Metacentric height experimentally and theoretically.

Kinematics: Types of fluid flow, continuity equation in 2D and 3D (Cartesian Co-ordinates only), velocity and acceleration, velocity potential function and stream function.

UNIT-3**11 Hours.**

Fluid Dynamics: Introduction equation of motion, Euler's equation of motion, Bernoulli's equation from first principles and also from Euler's equation, limitations of Bernoulli's equation.

UNIT-4**13 Hours.**

Fluid Flow Measurements : Venturimeter, orificemeter, pitot-tube, vertical orifice, V-Notch and rectangular notches.

Dimensional Analysis : Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh's method, Buckingham π theorem, dimensionless numbers, similitude, types of similitudes.

UNIT-5**12 Hours.**

Flow through pipes : Minor losses through pipes. Darcy's and Chezy's equation for loss of head due to friction in pipes. HGL and TEL.

Flow past immersed bodies : Drag, Lift, expression for lift and drag, boundary layer concept, displacement, momentum and energy thickness.

Introduction to compressible flow : Velocity of sound in a fluid, Mach number, Mach cone, propagation of pressure waves in a compressible fluid.

ESSENTIAL READINGS:

1. Oijush.K.Kundu :Fluid Mechanics , IRAM COCHEN, ELSEVIER, 3rd Ed. 2005.
2. Dr. Bansal Fluid Mechancis , R.K.Lakshmi Publications, 2004.

RECOMMENDED READING:

2. Dr.Jagadishlal Fluid Mechanics and hydraulics,: Metropolitan Book Co-Ltd., 1997.
3. Yunus A. Cingel John M.Oimbala Fluid Mechanics (SI Units),. Tata MaGrawHill, 2006.
4. John F.Douglas, Janul and M.Gasiosek and John Fluid Mechanics A.Swaffield, Pearson Education Asia, 5th ed., 2006
5. Fluid Mechanics and Fluid Power Engineering, Kumar.D.S, Kataria and Sons., 2004
6. Merle C. Potter, Elaine P.Scott Fluid Mechanics -.. Cengage learning

ME436 MECHANICAL MEASUREMENTS AND METROLOGY**PAPER DESCRIPTION:** *Provides basic knowledge about measurements.***PAPER OBJECTIVES:**

- *To study and understand the general concepts and terminologies of Measurement system, Definition of measurement and measurand, Block diagram of measurement. Static and Dynamic characteristics of measurement system.*
- *To study and understand Transducer Definition, Classification, and Performance Characteristics*
- *To study and understand the principles of calibration- definition, traceability, Infrastructural requirements of Calibration laboratory, Technical system requirements of Calibration laboratory.*

OUTCOME:

- *To calibrate the measurement devices.*
- *To measure the angular measurements using Sine bar, Sine centre.*
- *To measure the parameters of the micro objects like watch gear, nanobots and so on.*
- *To visualize the fringes of the reflected light from the highly polished specimen*
- *To measure the roughness of a specimen.*

LEVEL OF KNOWLEDGE: *Basic***UNIT-1:****13 Hours**

Standards of measurement: Definition and Objectives of metrology, Standards of length-International prototype meter, Imperial standard yard, Wave length standard, subdivision of standards, line and end standard, calibration of end bars (Numerical), Slip gauges, Wringing phenomena, Indian Standards (M-81, M-12), Numerical problems on building of slip gauges.

System of Limits, Fits, Tolerance and Gauging: Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly limits of size, Indian standards, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances,

definition of fits, types of fits and their designation (IS919-1963), geometrical tolerance, positional-tolerances, hole basis system, shaft basis system, classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges, Types of gauges- plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials.

UNIT-2:**13 Hours**

Comparators and Angular measurement: Introduction to comparators, characteristics, classification of comparators, mechanical comparators-Johnson Mikrokator, sigma comparators, dial indicator, optical comparators-principles, Zeiss ultra optimeter, electric and electronic comparators-principles, LVDT, pneumatic comparators, back pressure gauges, solex comparators. Angular measurements, bevel protractor, sine principle and use of sine bars, sine centre, use of angle gauges (numericals on building of angles), clinometers.

Interferometer and screw thread, gear measurement: Interferometer, interferometry, autocollimator. Optical flats. Terminology of screw threads, measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2-wire and 3-wire methods, best size wire. Tool maker's microscope, gear to, terminology, use of gear tooth vernier caliper and micrometer.

UNIT-3:**11 Hours**

Measurements and measurement systems: Definition, significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-times delay. Errors in measurement, classification of errors. Transducers, transfer efficiency, primary and secondary transducers, electrical, mechanical, electronic transducers, advantages of each type transducers.

Intermediate modifying and terminating devices: Mechanical systems, inherent problems, electrical intermediate modifying devices, input circuitry, ballast circuit, electronic amplifiers and telemetry. Terminating devices, mechanical, cathode ray oscilloscope, oscillographs, X-Y plotters.

UNIT-4:**11 Hours**

Measurement of force, torque and pressure: Principle, analytical balance, platform balance, proving ring. Torque measurement, Prony brake, hydraulic dynamometer. Pressure measurements, principle, use of elastic merijbers, Bridgemangaue, Mcloed gauge, Pirani gauge.

UNIT-5:**11 hours**

Temperature and strain measurement: Resistance thermometers, thermocouple, law of thermo couple, materials used for construction, pyrometer, optical pyrometer. Strain measurements, strain gauge, preparation and mounting of strain gauges, gauge factor, methods of strain measurement.

ESSENTIAL READINGS:

1. Beckwith marangoni and Llienhard Mechanical measurements, pearson education, 6th ed., 2006.
2. R.K. jain Engineering metrology, , khanna publishers, 1994.

RECOMMENDED READING:

1. Engineering metrology, I.C. Gupta, dhapat rai publications, delhi.
2. R..K. jain Mechanical measurements,
3. Alsutko, Jerry. D. Faulk, Industrial instrumentation, Thompson asia pvt. ltd.2002.
4. Ernest O. Doblin Measurement systems applications and design, mcgraw hill book co.

ME451 MECHANICAL MEASUREMENTS AND METROLOGY LABORATORY

PAPER DESCRIPTION: *Provides the knowledge about the various measuring devices and methods.*

PAPER OBJECTIVE: *To provide the working knowledge and importance of the metrology and the measurement and about calibration and its importance.*

Level of knowledge: Working.

SUBJECT DESCRIPTION:

This Laboratory has various experiments that aims at enabling the students to learn the concepts of Measurements and Metrology.

LEARNING OUTCOME:

- *Will be able to perform various calibrations, appreciate its application in various engineering application.*
- *Will be able to perform various measurements for various mechanical elements.*
- *Will be able to carry out measurement tests.*
- *To develop scientific, technical and experimental skills to the students.*
- *To correlate the theoretical principles with application based studies.*

Part-A: Mechanical measurements

1. Calibration of Pressure Gauge
2. Calibration of Thermocouple
3. Calibration of LVDT
4. Calibration of Load cell
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges.

Part-B: Metrology

1. Measurements using Optical Projector / Toolmaker Microscope.
2. Measurement of angle using Sine Center / Sine bar / bevel protractor
3. Measurement of alignment using Autocollimator / Roller set
4. Measurement of cutting tool forces using
 - a. Lathe tool Dynamometer
 - b. Drill tool Dynamometer.

5. Measurement of Screw thread Parameters using Two wire or Three-wire method.
6. Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator
7. Measurement of gear tooth profile using gear tooth vernier /Gear tooth micrometer
8. Calibration of Micrometer using slip gauges
9. Measurement using Optical Flats

ME452 MACHINE SHOP

PAPER DESCRIPTION: *Provides working knowledge about machine tools.*

PAPER OBJECTIVES:

- *Under Standing of various types of machines and their mechanisms, manufacturing processes of machine tool components.*
- *Performing experiments on the various machines gives the complete knowledge of the machines to the learner. The machine tools lab (Machine Shop) gives the industry environment exposure to the students.*
- *The student feel the industry environment while doing the experiments and operations on the specified machines.*
- *The students gain the master knowledge and skills when they complete the experiments at the end of semester.*

LEVEL OF KNOWLEDGE: *Working.*

LEARNING OUTCOME:

- *Will be able to prepare various mechanical element , appreciate its application in various engineering application.*
- *To develop scientific, technical and experimental skills to the students.*
- *To correlate the theoretical principles with application based studies.*

PART – A

Preparation of three models on lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning.

PART – B

Cutting of V Groove/ dovetail / Rectangular groove using a shaper.

Cutting of Gear Teeth using Milling Machine.

HE471 HOLISTIC EDUCATION

PAPER DESCRIPTION: *This paper contains three units which are Personal skills, Inter-personal Skills and Societal Skills.*

PAPER OBJECTIVES:

- *Holistic development of the individual adult in every student*
- *Knowing life and its principles*
- *Broadening the outlook to life*
- *Training to face the challenges of life*
- *Confidence creation and personality development*
- *Emotional control and stress management*
- *Creating awareness on duties, rights and obligations as a member of the Society*
- *Realizing Personal Freedom-its limits and limitations*
- *Developing the attitude to be a contributor and giver*
- *Realizing the real happiness in life*

LEVEL OF KNOWLEDGE: *Basic*

Personalskills	04Hours
Stress management	
Scientific temper	
Interpersonalskills	04Hours
Change management	
Networking and PR skills	
Societal skills	04Hours
Selected areas of the constitution	

RECOMMENDED READING:

1. "Modules on Holistic development" (Prepared by Core committee, Christ College)
2. Bradley C. McRae, "Practical Time management", International self-counsel Press Ltd., 2001
3. Ronald. B., Adler & Jeanne M. Elmhurst, "Communicating at work-Principles and practice for business and professions", McGraw Hill

SEMESTER V**ME531 DESIGN OF MACHINE ELEMENTS-I****OBJECTIVES:**

- *This course “Design of Machine Elements -I” is designed with the following objectives :*
- *The student shall gain appreciation and understanding of the design function in mechanical engineering, the steps involved in designing and the relation of design activity with manufacturing activity.*
- *Shall be able to choose proper materials to different machine elements depending on their physical and mechanical properties. Thus he shall be able to apply the knowledge of material science in real life usage.*
- *Student shall gain a thorough understanding of the different types of failure modes and criteria. He will be conversant with various failure theories and be able to judge which criterion is to be applied in which situation.*
- *Student shall gain design knowledge of the different*
- *t types of elements used in the machine design process. Eg., fasteners, shafts, couplings etc. and will be able to design these elements for each application*

LEARNING OUTCOME:

- *To describe the various design process.*
- *To explain the various problem solving strategies.*
- *To explain the embodiment design and detail design.*
- *To explain the parameters of failures.*
- *To explain the parameter design and tolerance design.*
- *Will acquire skill to do select proper material for specific application.*
- *Will be in a position to do design for industrial application.*
- *Will be able to do design of mechanical elements.*
- *Will have sufficient ability to optimize.*
- *Enhances the capabilities to assume suitable technical specifications.*

UNIT- 1**12 Hours.**

INTRODUCTION: Definitions: normal, shear, biaxial and tri axial stresses, Stress tensor, Principal Stresses. Engineering Materials and their mechanical properties, Stress-Strain diagrams, Stress Analysis, Design considerations: Codes and Standards.

DESIGN FOR STATIC & IMPACT STRENGTH:

Static Strength: Static loads and factor of safety, Theories of failure: Maximum normal stress theory, Maximum shear stress theory, Maximum strain theory, Strain energy theory, Distortion energy theory. Failure of brittle and ductile materials, Stress concentration, Determination of Stress concentration factor.

UNIT – 2**12 Hours**

Impact Strength: Introduction, Impact stresses due to axial, bending and torsional loads, effect of inertia.

DESIGN FOR FATIGUE STRENGTH: Introduction- S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit, Modifying factors: size effect, surface effect, Stress concentration effects, Fluctuating stresses, Goodman and Soderberg relationship, stresses due to combined loading, cumulative fatigue damage.

UNIT – 3**12 Hours.**

THREADED FASTENERS: Stresses in threaded fasteners, Effect of initial tension, Design of threaded fasteners under static, dynamic and impact loads, Design of eccentrically loaded bolted joints.

DESIGN OF SHAFTS: Torsion of shafts, design for strength and rigidity with steady loading, ASME codes for power transmission shafting, shafts under fluctuating loads and combined loads.

UNIT – 4**12 Hours.**

COTTER AND KNUCKLE JOINTS, KEYS AND COUPLINGS: Design of Cotter and Knuckle joints, Keys: Types of keys, Design of keys, Couplings: Rigid and flexible couplings, Flange coupling, Bush and Pin type coupling and Oldham's coupling.

UNIT – 5**12 Hours.**

Riveted and Welded Joints – Types, rivet materials, failures of riveted joints, Joint Efficiency, Boiler Joints, Lozanze Joints, Riveted Brackets. Welded Joints – Types, Strength of butt and fillet welds, eccentrically loaded welded joints.

Power Screws: Mechanics of power screw, Stresses in power screws, efficiency and self-locking, Design of Power Screw, Design of Screw Jack: (Complete Design).

ESSENTIAL READINGS

1. **Mechanical Engineering Design**, Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6th Edition 2009.
2. **Design of Machine Elements**, V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007.

DESIGN DATA HANDBOOK

1. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Ed.
2. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBS Publication
3. Design Data Hand Book, H.G. Patil, Shri Shashi Prakashan, Belgaum.

RECOMMENDED READING

1. Machine Design, Robert L. Norton, Pearson Education Asia, 2001.
2. Design of Machine Elements, M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh, Pearson Education, 2006.
3. Machine Design, Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S.K. Somani, Tata McGraw Hill Publishing Company Ltd., New Delhi, Special Indian Edition, 2008.
4. Fundamentals of Machine Component Design, Robert C. Juvinall and Kurt M Marshek, Wiley India Pvt. Ltd., New Delhi, 3rd Edition, 2007.

ME532 ENERGY ENGINEERING**UNIT-1****12 Hours.**

STEAM POWER PLANT: Different Types of Fuels used for steam generation, Equipment for burning coal in lump form, stokers, different types, Oil burners, Advantages and Disadvantages of using pulverized fuel, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverized fuel furnaces, cyclone furnace, Coal and ash handling, Generation of steam using forced circulation, high and supercritical pressures.

UNIT – 2**12 Hours****A BRIEF ACCOUNT OF BENSON, VELOX SCHMIDT STEAM GENERATORS.**

Chimneys: Natural, forced, induced and balanced draft, Calculations and numericals involving height of chimney to produce a given draft. Cooling towers and Ponds. Accessories for the Steam generators such as Superheaters, Desuperheater, control of superheaters, Economizers, Air pre-heaters and re-heaters.

DIESEL ENGINE POWER PLANT: Applications of Diesel Engines in Power field. Method of starting Diesel engines. Auxiliaries like cooling and lubrication system, filters, centrifuges, Oil heaters, intake and exhaust system, Layout of diesel power plant.

UNIT – 3**12 Hours.**

HYDRO-ELECTRIC PLANTS: Hydrographs, flow duration and mass curves, unit hydrograph and numericals. Storage and pondage, pumped storage plants, low, medium and high head plants, Penstock, water hammer, surge tanks, gates and valves. General layout of hydel power plants.

Nuclear Power Plant: Principles of release of nuclear energy; Fusion and fission reactions. Nuclear fuels used in the reactors. Multiplication and thermal utilization factors. Elements of the nuclear reactor; moderator, control rod, fuel rods, coolants. Brief description of reactors of the following types-Pressurized water reactor, Boiling water reactor, Sodium graphite reactor, Fast Breeder reactor, Homogeneous graphite reactor and gas cooled reactor, Radiation hazards, Shieldings, Radio active waste disposal.

UNIT – 4**12 Hours.**

SOLAR ENERGY: Solar Extra terrestrial radiation and radiation at the earth surface, radiation-measuring instruments, working principles of solar flat plate collectors, solar pond and photovoltaic conversion (Numerical Examples).

WIND ENERGY: Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, wind machines; Types of wind machines and their characteristics, horizontal and vertical axis wind mills, coefficient of performance of a wind mill rotor (Numerical Examples).

UNIT – 5**12 Hours.**

TIDAL POWER: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, limitations.

OCEAN THERMAL ENERGY CONVERSION: Principle of working, Rankine cycle, problems associated with OTEC.

GEO THERMAL ENERGY CONVERSION: Principle of working, types of geothermal station with schematic diagram, problems associated with geothermal conversion, scope of geothermal energy.

ENERGY FROM BIO MASS: Photosynthesis, photosynthetic oxygen production, energy plantation.

BIO CHEMICAL ROUTE: Biogas production from organic wastes by anaerobic fermentation, classification of bio gas plants, factors affecting bio gas generation.

THERMO CHEMICAL ROUTE: Thermo chemical conversion on bio mass, types of gasifiers.

ESSENTIAL READINGS:

1. Power Plant Engineering, P. K. Nag Tata McGraw Hill 2nd edn 2001.
2. Power Plant Engineering, Domakundawar, Dhanpath Rai sons. 2003

RECOMMENDED READING:

1. Power Plant Engineering, R. K. Rajput, Laxmi publication, New Delhi.
2. Principles of Energy conversion, A. W. Culp Jr., McGraw Hill. 1996
3. Non conventional Energy sources, G D Rai Khanna Publishers.
4. Non conventional resources, B H Khan TMH - 2007

ME533 DYNAMICS OF MACHINES**OBJECTIVES:**

Student will acquire knowledge of kinematic analyses of rigid body systems , concepts of planar, inverse, Newtonian dynamic analyses of mechanisms and machines, concepts of three-dimensional, inverse, Newtonian dynamic analyses of fixed-axis rotation of non-symmetric bodies,concepts of static and dynamic mass balancing and flywheels, concepts of generalized forces and the Principle of Virtual Work.

LEARNING OUTCOME:

- *Understanding of the concepts of displacement, velocity and acceleration as vectors and how to determine them.*
- *Understanding of the notion of a force as a vector.*
- *Ability to understand concepts of kinetic, potential and mechanical energies and the concept of a conservative force.*
- *Ability to correctly draw the free-body diagram (FBD) for the system.*
- *Ability to conduct dynamic force analysis for various mechanisms.*
- *Ability to do analysis of frictions in different members like belt drives.*
- *Ability to do analysis for balancing of rotating masses and reciprocating masses.*
- *Ability to do governor mechanism classification and analyze the forces in the mechanisms.*

UNIT 1:**12 Hours.**

Static Force Analysis: Introduction: Static equilibrium. Equilibrium of two and three force members. Members with two forces and torque. Free body diagrams. Principle of virtual work. Static force analysis of four bar mechanism and slider-crank mechanism with and without friction.

UNIT 2:**12 Hours.**

Dynamic Force Analysis: D'Alembert's principle, Inertia force, inertia torque. Dynamic force analysis of four-bar mechanism and slider crank mechanism. Dynamically equivalent systems. Turning moment diagrams and flywheels. Fluctuation of Energy. Determination of size of flywheels.

UNIT 3:**12 Hours.**

Friction and Belt Drives: Definitions: Types of friction: laws of friction, Friction in pivot and collar bearings. Belt drives: Flat belt drives. ratio of belt tensions, centrifugal tension, power transmitted.

Balancing of Rotating Masses: Static and dynamic balancing. Balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes.

UNIT 4:**12 Hours.**

Balancing of Reciprocating Masses: Inertia effect of crank and connecting rod, single cylinder engine, balancing in multi cylinder-inline engine (primary & secondary forces), V-type engine; Radial engine – Direct and reverse crank method.

Governors: Types of governors; force analysis of Porter and Hartnell governors. Controlling force. stability, sensitiveness. Isochronism, effort and power .

UNIT 5:**12 Hours**

.Gyroscope: Vectorial representation of angular motion. Gyroscopic couple. Effect of gyroscopic couple on ship, plane disc, aeroplane, stability of two wheelers and four wheelers.

Analysis of Cams: Analysis of Tangent cam with roller follower and Circular arc cam operating flat faced and roller followers. Undercutting in Cams

ESSENTIAL READINGS:

- 1 Theory of Machines, Sadhu Singh, Pearson Education. 2nd edition. 2007.
- 2 Theory of Machines, Rattan S.S. Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition, 2009.

RECOMMENDED READING:

1. "Theory of Machines & Mechanisms", J.J. Uicker, , G.R. Pennock, J.E. Shigley. OXFORD 3rd Ed. 2009
2. Mechanism and Machine Theory, A.G.Ambekar PHI, 2007

ME534 TURBO MACHINES**OBJECTIVES:**

- *To understand the basics of turbomachinery and to identify various types of turbomachinery. To understand the major turbo machinery operations and its basics.*
- *To understand the 2D and 3D steady flow phenomena in turbomachine components*
- *Apply the Euler's equation for turbo machinery to analyze energy transfer in turbo machines.*
- *To compute efficiencies of various turbo machines and to Analyze and select axial-flow turbines and compressors.*
- *To understand and Analyze and select radial-flow turbo machines for various industrial applications.*
- *To carry various Performance thermal cycle analysis on turbines.*

UNIT -1**12 Hours.**

Introduction: Definition of turbomachine, parts of turbomachines, Comparison with positive displacement machines, Classification, Static and Stagnation states- Incompressible fluids and perfect gases, Application of first and second law's of thermodynamics to turbomachines, Efficiencies of turbomachines. Problems.

Energy exchange in Turbomachines: Euler's turbine equation, Alternate form of Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor, Problems.

UNIT – 2**12 Hours.**

General Analysis of Turbomachines: Radial flow compressors and pumps – general analysis, Expression for degree of reaction, velocity triangles, Effect of blade discharge angle on energy transfer and degree of reaction, Effect of blade discharge angle on performance, Theoretical head – capacity relationship, General analysis of axial flow pumps and compressors, degree of reaction, velocity triangles, Problems.

UNIT – 3**12 Hours.**

Dimensionless analysis and thermodynamics of fluid flow: Dimensionless parameters and their significance, Effect of Reynold's number, Unit and specific quantities, model studies. Overall isentropic efficiency, stage efficiency (their comparison) and polytropic efficiency for both compression and expansion processes. Reheat factor for expansion process.

Steam Turbines: Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor, Reaction turbine – Parsons's turbine, condition for maximum utilization factor, reaction staging. Problems.

UNIT – 4**12 Hours.**

Hydraulic Turbines: Classification, Different efficiencies, Pelton turbine – velocity triangles, design parameters, Maximum efficiency. Francis turbine - velocity triangles, design parameters, runner shapes for different blade speeds. Draft tubes- Types and functions. Kaplan and Propeller turbines - velocity triangles, design parameters. Problems.

UNIT – 5**12 Hours.**

Centrifugal Pumps: Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel. Problems.

Centrifugal Compressors: Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency and surging and problems.

Axial flow Compressors: Expression for pressure ratio developed in a stage, work done factor, efficiencies and stalling. Problems.

(Note: Since dimensional analysis is covered in Fluid Mechanics subject, questions on dimensional analysis may not be given for examinations. However, dimensional parameters and model studies may be given more weightage.)

ESSENTIAL READINGS:

1. An Introduction to Energy Conversion, Volume III, Turbomachinery, V. Kadambi and Manohar Prasad, New Age International Publishers, reprint 2008.
2. Turbines, Compressors & Fans, S. M. Yahya, Tata McGraw Hill Co. Ltd., 2nd edition, 2002

RECOMMENDED READING:

1. Principals of Turbomachines, D. G. Shepherd, The Macmillan Company (1964).
2. Fluid Mechanics & Thermodynamics of Turbomachines, S. L. Dixon, Elsevier (2005).
3. Turbomachine, B.K.Venkanna PHI, 2007

ME535 MANUFACTURING PROCESS III**OBJECTIVES:**

- *Develop understanding of basic and advanced manufacturing processes and capabilities of each.*
- *Extend basis knowledge to solve manufacturing processes related problems.*
- *Develop an understanding of Concurrent Engineering and the importance to manufacturing industries.*
- *Enhance ability to determine what is given and what to find.*
- *Learn to make engineering judgments.*
- *Learn the impact that modern manufacturing techniques have on human advancement.*
- *Understand what manufacturing processes references are available.*
- *Discuss current manufacturing issues.*
- *Emphasize the problem solving process and application techniques.*

LEARNING OUTCOME:

- *Will be able to implement specific advanced and emerging manufacturing technologies in modern industry.*
- *Will be able to describe the process of machining in various types of materials.*
- *Will describe the operations and utilization of lathe, drilling, milling, grinding machine, etc.*
- *Will describe the tool nomenclature, and design the tool for specific operations.*
- *Will apply Merchant's analysis for tool wear, failure and life.*

UNIT – 1**12 Hours.**

INTRODUCTION AND CONCEPTS: Classification of metal working processes, characteristics of wrought products, advantages and limitations of metal working processes. Concepts of true stress, true strain, triaxial & biaxial stresses. Determination of flow stress. Principal stresses, Tresca & Von-Mises yield criteria, concepts of plane stress & plane strain.

EFFECTS OF PARAMETERS: Temperature, strain rate, friction and lubrication, hydrostatic pressure in metalworking, Deformation zone geometry, workability of materials, Residual stresses in wrought products.

UNIT – 2**12 Hours.**

FORGING: Classification of forging processes. Forging machines & equipment. Expressions for forging pressures & load in open die forging and closed die forging by slab analysis, concepts of friction hill and factors affecting it. Die-design parameters. Material flow lines in forging. Forging defects, Residual stresses in forging. Simple problems.

ROLLING: Classification of Rolling processes. Types of rolling mills, expression for Rolling load. Roll separating force. Frictional losses in bearing, power required in rolling, Effects of front & back tensions, friction, friction hill. Maximum possible reduction. Defects in rolled products. Rolling variables, simple problems.

UNIT – 3**12 Hours.**

DRAWING: Drawing equipment & dies, expression for drawing load by slab analysis, power requirement. Redundant work and its estimation, optimal cone angle & dead zone formation, drawing variables, Tube drawing, classification of tube drawing, simple problems.

EXTRUSION: Types of extrusion processes, extrusion equipment & dies, deformation, lubrication & defects in extrusion. Extrusion dies, Extrusion of seamless tubes. Extrusion variables, simple problem

UNIT – 4**12 Hours.**

SHEET & METAL FORMING: Forming methods, dies & punches, progressive die, compound die, combination die. Rubber forming. Open back inclinable press (OBI press), piercing, blanking, bending, deep drawing, LDR in drawing, Forming limit criterion, defects of drawn products, stretch forming. Roll bending & contouring, Simple problems

UNIT – 5**12 Hours.**

HIGH ENERGY RATE FORMING METHODS: Principles, advantages and applications, explosive forming, electro hydraulic forming, Electromagnetic forming.

POWDER METALLURGY: Basic steps in Powder metallurgy brief description of methods of production of metal powders, conditioning and blending powders, compaction and sintering application of powder metallurgy components, advantages and limitations.

ESSENTIAL READINGS:

1. Mechanical metallurgy (SI units), G.E. Dieter, Mc Graw Hill pub.2001
2. Manufacturing Process – III, Dr. K.Radhakrishna, Sapna Book House, 2009.

RECOMMENDED READING:

1. Materials and Processes in Manufacturing, E.paul, Degramo, J.T. Black, Ronald, A.K. Prentice -hall of India 2002
2. Principles of Industrial metal working process, G.W. Rowe, CBSpub. 2002
3. Manufacturing Science, Amitabha Ghosh & A.K. Malik - East -Westpress 2001
4. Technology of Metal Forming Process, Surendra kumar, PHI – 2008

ME536 COMPUTER AIDED MACHINE DRAWING**OBJECTIVES:**

- *To visualize an object and convert it into a drawing.*
- *To gain knowledge of conventional representation of various machining and mechanical details as per IS.*
- *To become conversant with 2-D and 3-D drafting.*
- *Gaining the knowledge of CAD software and its features for effective representation of machine components and their assembly.*
- *Understand the format and Standards of Machine Drawing.*
- *Understand the technical information on machine drawings.*
- *Understanding and drawing of various views and machine components.*
- *Learning how to assemble and disassemble important parts used in major mechanical engineering applications.*

LEARNING OUTCOME

- *Will be able to read and understand the machine drawings.*
- *Will be able to prepare machine components drawings.*
- *Will be able to do assembly drawings.*
- *Will be in a position to do drawings and assembly using computer.*

INTRODUCTION:

Review of graphic interface of the software. Review of basic sketching commands and navigational commands. Starting a new drawing sheet. Sheet sizes. Naming a drawing, Drawing units, grid and snap.

PART-A**UNIT 1:**

Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on, axis inclinations, spheres and hollow solids). True shape of sections.

Orthographic Views: Conversion of pictorial views into orthographic projections. of **simple machine parts** with or without section. (Bureau of Indian Standards conventions are to be followed for the drawings) Hidden line conventions. Precedence of lines.

UNIT 2:**08 Hours**

Thread Forms: Thread terminology, sectional views of threads. ISO Metric (Internal & External) BSW (Internal & External) square and Acme. Sellers thread, American Standard thread.

Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw.

PART-B**UNIT 3:****08 Hours****Keys & Joints :**

Parallel key, Taper key, Feather key, Gibhead key and Woodruff key

Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets). cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.

UNIT 4:**08 Hours****Couplings:**

Split Muff coupling, Protected type flanged coupling, pin (bush) type flexible coupling, Oldham's coupling and universal coupling (Hooks' Joint)

PART - C**Assembly Drawings****(Part drawings should be given)**

1. Plummer block (Pedestal Bearing)
2. Rams Bottom Safety Valve
3. I.C. Engine connecting rod
4. Screw jack (Bottle type)

5. Tailstock of lathe
6. Machine vice
7. Tool Head of a shaper

ESSENTIAL READINGS:

1. 'A Primer on Computer Aided Machine Drawing-2007', Published by VTU, Belgaum.
2. 'Machine Drawing', N.D.Bhat & V.M.Panchal

RECOMMENDED READING:

1. 'A Text Book of Computer Aided Machine Drawing', S. Trymbaka Murthy, CBS Publishers, New Delhi, 2007
2. 'Machine Drawing', K.R. Gopala Krishna, Subhash Publication.
3. 'Machine Drawing with Auto CAD', Goutam Pohit & Goutham Ghosh, 1st Indian print Pearson Education, 2005
4. 'Auto CAD 2006, for engineers and designers', Sham Tickoo. Dream tech 2005
5. 'Machine Drawing', N. Siddeshwar, P. Kanniah, V.V.S. Sastri, published by Tata Mc GrawHill,2006

ME551 FLUID MECHANICS AND MACHINES LABORATORY

PAPER DESCRIPTION: *Provides working knowledge of fluid mechanics and machines.*

PAPER OBJECTIVE:

- *To develop skills in the field of fluid mechanics and machines.*
- *Verify the principles of the course*
- *Application of the theory , Understanding of fundamentals of the subject.*
- *Be in a position to relate theory and practice,*

Level of knowledge: *Working.*

SUBJECT DESCRIPTION:

This Laboratory has various experiments that aims at enabling the students to learn the concepts of fluid mechanics and machines.

LEARNING OUTCOME:

- *Will be able to apply the concepts of fluid mechanics and machines, appreciate its application in various engineering application.*
- *Will be able to perform various test of fluid mechanics and machines for various mechanical properties.*
- *Will be able to carry out performance tests on fluid mechanics and machines.*
- *To develop scientific, technical and experimental skills to the students.*
- *To correlate the theoretical principles with application based studies.*

PART - A

1. Determination of coefficient of friction of flow in a pipe.
2. Determination of minor losses in flow through pipes.
3. Determination of force developed by impact of jets on vanes.
4. Calibration of flow measuring Devices like
 - a) Orifice Plate Meter
 - b) Nozzle
 - c) Venturimeter
 - d) V-notch

PART - B

5. Performance testing of Turbines
 3. Pelton wheel
 4. Francis Turbine
 5. Kaplan Turbines
6. Performance testing of Pumps
 - (vii) Single stage / Multi stage centrifugal pumps
 - (viii) Reciprocating pump
7. Performance test of a two stage Reciprocating Air Compressor
8. Performance test on an Air Blower

ME552 ENERGY CONVERSION ENGINEERING LABORATORY

PAPER DESCRIPTION: *Provides working knowledge of energy conversion engineering.*

PAPER OBJECTIVE:

- *To develop skills in the field of energy conversion engineering.*
- *Verify the principles of the course*
- *Application of the theory , Understanding of fundamentals of the subject.*
- *Be in a position to relate theory and practice,*

Level of knowledge: Working.

SUBJECT DESCRIPTION:

This Laboratory has various experiments that aim at enabling the students to learn the concepts of energy conversion engineering.

LEARNING OUTCOME:

- *Will be able to apply the concepts of energy conversion engineering, appreciate its application in various engineering application.*
- *Will be able to perform various test of energy conversion engineering for various mechanical properties.*
- *Will be able to carry out performance tests on energy conversion engineering.*
- *To develop scientific, technical and experimental skills to the students.*
- *To correlate the theoretical principles with application based studies.*

PART - A

1. Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Martin (closed) / Cleavland (Open Cup) Apparatus.
2. Determination of Calorific value of solid, liquid and gaseous fuels.
3. Determination of Viscosity of a lubricating oil using Redwoods, Saybolts and Torsion Viscometers.
4. Valve Timing/port opening diagram of an I.C. engine (4 stroke/2 stroke).
5. Use of planimeter

PART - B

1. Performance Tests on I.C. Engines, Calculations of IP, BP, Thermal efficiencies, SFC, FP, heat balance sheet for

- (a) Four stroke Diesel Engine
- (b) Four stroke Petrol Engine
- (c) Multi Cylinder Diesel/Petrol Engine, (Morse test)
- (d) Two stroke Petrol Engine
- (e) Variable Compression Ratio I.C. Engine.

SEMESTER VI**ME631 DESIGN OF MACHINE ELEMENTS – II****OBJECTIVES:**

This course “Design of Machine Elements -II” is designed with the following objectives :

- *The student shall gain appreciation and understanding of the design function in mechanical engineering, the steps involved in designing and the relation of design activity with manufacturing activity.*
- *Shall be able to choose proper materials to different machine elements depending on their physical and mechanical properties. Thus he shall be able to apply the knowledge of material science in real life usage.*
- *Student shall gain a thorough understanding of the different types of failure modes and criteria. He will be conversant with various failure theories and be able to judge which criterion is to be applied in which situation.*
- *Student shall gain design knowledge of the different types of elements used in the machine design process. Eg., fasteners, shafts, couplings etc. and will be able to design these elements for each application*

LEARNING OUTCOME:

- *To describe the various design process.*
- *To explain the various problem solving strategies.*
- *To explain the embodiment design and detail design.*
- *To explain the parameters of failures.*
- *To explain the parameter design and tolerance design.*
- *Will acquire skill to do select proper material for specific application.*
- *Will be in a position to do design for industrial application.*
- *Will be able to do design of mechanical elements.*
- *Will have sufficient ability to optimize.*
- *Enhances the capabilities to assume suitable technical specifications.*

UNIT - 1**13 Hours.**

Curved Beams: Stresses in curved beams of standard cross sections used in crane hook, punching presses & clamps, closed rings and links

Cylinders & Cylinder Heads: Review of Lamé's Equations; compound cylinders, stresses due to different types of fits, cylinder heads, flats.

UNIT – 2**12 Hours.**

Springs: Types of springs - stresses in Helical coil springs of circular and non-circular cross sections. Tension and compression springs, springs under fluctuating loads, Leaf Springs: Stresses in leaf springs. Equalized stresses, Energy stored in springs, Torsion, Belleville and Rubber springs.

UNIT – 3**13 Hours**

Spur & Helical Gears: Spur Gears: Definitions, stresses in gear tooth: Lewis equation and form factor, Design for strength, Dynamic load and wear load. Helical Gears: Definitions, formative number of teeth, Design based on strength, dynamic and wear loads.

Bevel and Worm Gears: Bevel Gears: Definitions, formative number of teeth, Design based on strength, dynamic and wear loads. Worm Gears: Definitions, Design based on strength, dynamic, wear loads and efficiency of worm gear drives.

UNIT – 4**11 Hours.**

Clutches & Brakes: Design of Clutches: Single plate, multi plate and cone clutches. Design of Brakes: Block and Band brakes: Self locking of brakes: Heat generation in Brakes.

UNIT – 5**11 Hours.**

Lubrication and Bearings: Lubricants and their properties, Mechanisms of Lubrication bearing modulus, coefficient of friction, minimum oil film thickness, Heat Generated, Heat dissipated, Bearing Materials, Examples of journal bearing and thrust bearing design.

IC Engine Parts: Design of piston, connecting rod and crank shaft.

ESSENTIAL READINGS

1. Mechanical Engineering Design, Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6th Edition 2003.
2. Design of Machine Elements, V. B Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007

REFERNCE BOOKS

1. Machine Design, Robert L. Norton, Pearson Education Asia, 2001.
2. Design of Machine Elements, M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh, Pearson Education, 2006.
3. Machine Design, Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S.K. Somani, Tata McGraw Hill Publishing Company Ltd., New Delhi, Special Indian Edition, 2008.
4. Machine Design, A CAD Approach: Andrew D DIMAROGONAS, John Wiley Sons, Inc, 2

DESIGN DATA HAND BOOK

1. Design Data Hand Book , K. Lingaiah, McGraw Hill, 2nd Ed.
2. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBS Publication
3. Design Data Hand Book, H.G. Patil, Shri Shashi Prakashan, Belgaum.

ME632 HEAT AND MASS TRANSFER**OBJECTIVES:**

- *Students will understand the basic concepts of conduction, convection and radiation heat transfer.*
- *Students will understand how to formulate and be able to solve one and two dimensional conduction heat transfer problems. Solution techniques will include both closed form and numerical methods. Convection effects will be included as boundary conditions.*
- *Students will understand the fundamentals of the relationship between fluid flow, convection heat transfer and mass transfer.*
- *Students will apply empirical correlations for both forced and free convection to determine values for the convection heat transfer coefficient. They will then calculate heat transfer rates using the coefficients.*
- *Students will understand the basic concepts of radiation heat transfer to include both black body radiation and gray body radiation.*
- *Students will be able to evaluate radiation view factors using tables and the view factor relationships.*

LEARNING OUTCOME:

- *Students gain in depth knowledge in various modes of heat transfer equipping them to apply this knowledge in real life engineering situations like design of IC engines, heat exchangers, etc.*
- *Students obtain sound theoretical knowledge on heat conduction enabling them to design energy efficient industrial systems.*
- *Students acquire adequate knowledge in heat transfer in convection and radiation modes that will enable them to conceptualize, design and commission alternate energy systems.*
- *A sound knowledge in “Heat and Mass Transfer” coupled with the understanding of Thermodynamics enables students in developing green technologies that are essential in the future for sustainable development.*

UNIT-1**11 Hours**

INTRODUCTORY CONCEPTS AND DEFINITIONS: Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; radiation heat transfer; combined heat transfer mechanism. Boundary conditions of 1st, 2nd and 3rd Kind

CONDUCTION: Derivation of general three dimensional conduction equation in Cartesian coordinate, special cases, discussion on 3-D conduction in cylindrical and spherical coordinate systems (No derivation). One dimensional conduction equations in rectangular, cylindrical and spherical coordinates for plane and composite walls. Overall heat transfer coefficient. Thermal contact resistance.

UNIT – 2**13 Hours**

VARIABLE THERMAL CONDUCTIVITY: Derivation for heat flow and temperature distribution in plane wall. Critical thickness of insulation without heat generation, Thermal resistance concept & its importance. Heat transfer in extended surfaces of uniform cross-section without heat generation, Long fin, short fin with insulated tip and without insulated tip and fin connected between two heat sources. Fin efficiency and effectiveness. Numerical problems.

ONE-DIMENSIONAL TRANSIENT CONDUCTION: Conduction in solids with negligible internal temperature gradient (Lumped system analysis), Use of Transient temperature charts (Heisler's charts) for transient conduction in slab, long cylinder and sphere; use of transient temperature charts for transient conduction in semi-infinite solids. Numerical Problems.

UNIT – 3**13 Hours.**

CONCEPTS AND BASIC RELATIONS IN BOUNDARY LAYERS: Flow over a body velocity boundary layer; critical Reynolds number; general expressions for drag coefficient and drag force; thermal boundary layer; general expression for local heat transfer coefficient; Average heat transfer coefficient; Nusselt number. Flow inside a duct- velocity boundary layer, hydrodynamic entrance length and hydro dynamically developed flow; flow through tubes (internal flow discussion only). Numericals based on empirical relation given in data handbook.

FREE OR NATURAL CONVECTION: Application of dimensional analysis for free convection- physical significance of Grashoff number; use of correlations of free convection in

vertical, horizontal and inclined flat plates, vertical and horizontal cylinders and spheres, Numerical problems.

UNIT – 4**13 Hours.**

FORCED CONVECTIONS: Applications of dimensional analysis for forced convection. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydro dynamically and thermally developed flows inside a duct, use of correlations for flow over a flat plate, over a cylinder and sphere. Numerical problems.

HEAT EXCHANGERS: Classification of heat exchangers; overall heat transfer coefficient, fouling and fouling factor; LMTD, Effectiveness-NTU methods of analysis of heat exchangers. Numerical problems.

UNIT – 5**11 Hours.**

RADIATION HEAT TRANSFER: Thermal radiation; definitions of various terms used in radiation heat transfer; Stefan-Boltzman law, Kirchoff's law, Planck's law and Wein's displacement law. Radiation heat exchange between two parallel infinite black surfaces, between two parallel infinite gray surfaces; effect of radiation shield; intensity of radiation and solid angle; Lambert's law; radiation heat exchange between two finite surfaces-configuration factor or view factor. Numerical problems.

ESSENTIAL READINGS:

1. Heat & Mass transfer, Tirumaleshwar, Pearson education 2006
2. Heat transfer-A basic approach, Ozisik, Tata Mc Graw Hill 2002

RECOMMENDED READING:

1. Heat transfer, a practical approach, Yunus A- Cengel Tata Mc Graw Hill
2. Principles of heat transfer, Kreith Thomas Learning 2001
3. Fundamentals of heat and mass transfer, Frenk P. Incropera and David P. Dewitt, John Wiley and son's.
4. Heat transfer, P.K. Nag, Tata Mc Graw Hill 2002.

ME633 FINITE ELEMENT METHODS**OBJECTIVES:**

- *To provide the student with some knowledge and analysis skills in applying basic laws in mechanics and integration by parts to develop element equation for a spring element and steps used in solving the problem by finite element method. (A, B, C)*
- *To develop the student's skills in applying the basic matrix operation to form a global matrix equation and enforce the concept of steps in obtaining solutions for a truss structures (A,B,C)*
- *To develop the student's skills in applying the Hermite interpolation functions to solve beam problems. (A,B,C)*
- *To provide the student with some knowledge and analysis skills in forming basic data required in a FEM computer program. (A,B,C)*
- *To develop the student's skills in applying the Gaussian quadrature in computing integration in FEM. (A, B, C)*
- *To provide the student with some knowledge in isoparametric transformation. (A,B,C)*

LEARNING OUTCOME

- *Know the behavior of the element under different loading condition.*
- *Able to model irregular bodies and also find the areas of it.*
- *To find approximate solution for differential equations.*
- *To minimize an error using FEA software and get faster solution.*

UNIT-1**12 Hours.**

Introduction: Equilibrium equations in elasticity subjected to body force, traction forces, and stress-strain relations for plane stress and plane strains. General description of Finite Element Method, Application and limitations. Types of elements based on geometry. Node numbering, Half band width.

UNIT-2**12 Hours.**

Basic Procedure: Euler - Lagrange equation for bar, beam (cantilever / simply supported fixed) Principle of virtual work, principle of minimum potential energy, Raleigh's Ritz method. Direct approach for stiffness matrix formulation of bar element. Galerkin's method.

UNIT-3**12 Hours.**

Interpolation Models: Interpolation polynomials- Linear, quadratic and cubic. Simplex complex and multiplex elements. 2D PASCAL's triangle. CST elements-Shape functions and Nodal load vector, Strain displacement matrix and Jacobian for triangular and rectangular element.

Solution of 1-D Bars: Solutions of bars and stepped bars for displacements, reactions and stresses by using penalty approach and elimination approach. Gauss-elimination technique.

UNIT-4**12 Hours.**

Higher Order Elements: Lagrange's interpolation, Higher order one dimensional elements- Quadratic and cubic element and their shape functions. Shape function of 2-D quadrilateral element-linear, quadratic element Iso-parametric, Sub parametric and Super parametric elements. numerical integration : 1, 2 and 3 gauge point for 1D and 2D cases.

Trusses: Stiffness matrix of Truss element. Numerical problems.

UNIT-5**12 Hours.**

Beams: Hermite shape functions for beam element, Derivation of stiffness matrix. Numerical problems of beams carrying concentrated, UDL and linearly varying loads.

Heat Transfer: Steady state heat transfer, 1D heat conduction governing equations. Functional approach for heat conduction. Galerkin's approach for heat conduction. 1D heat transfer in thin fins.

ESSENTIAL READING:

- 1 Finite Elements in Engineering, T.R.Chandrupatla, A.D Belegunde, 3rd Ed PHI.
- 2 Finite Element Method in Engineering, S.S. Rao, 4th Edition, Elsevier, 2006.

RECOMMENDED READING:

- 1.Finite Element Methods for Engineers U.S. Dixit, Cengage Learning, 2009
- 2.Concepts and applications of Finite Element Analysis, R.D. Cook D.S Maltus, M.E Plesha, R.J.Witt, Wiley 4th Ed, 2009
- 3.Finite Element Methods, Daryl. L. Logon, Thomson Learning 3rd edition, 2001.
- 4.Finite Element Method, J.N.Reddy, McGraw -Hill International Edition.

ME634 MECHATRONICS & MICROPROCESSOR**OBJECTIVE:**

- *Implement Mechatronic solutions to a given specification.*
- *Produce software solutions for a modern microprocessor-based Mechatronic system.*
- *Apply knowledge of control, sensors and actuators to control a Mechatronic system.*
- *Demonstrate the competence in developing advanced microprocessor-based Mechatronic products.*

LEARNING OUTCOME:

- *Will be in a position to understand and implement the control engineering concepts in real life applications.*
- *Can effectively use the various electro mechanical sensors for building various devices in real life applications.*
- *Can use the various soft various soft wares to simulate and understand the functioning of mechatronic devices.*
- *Effective use of microprocessors in mechanical applications*

UNIT – 1**12 Hours.**

Introduction to Mechatronic Systems: Measurement and control systems Their elements and functions, Microprocessor based controllers.

Review of Transducers and Sensors: Definition and classification of transducers. Definition and classification of sensors. Principle of working and applications of light sensors, proximity sensors and Hall effect sensors.

UNIT 2**12 Hours.**

Electrical Actuation Systems: Electrical systems, Mechanical switches, solid-state switches, solenoids, DC & AC motors, Stepper motors and their merits and demerits. **Signal Conditioning:** Introduction to signal conditioning. The operational amplifier, Protection,

Filtering, Wheatstone bridge, Digital signals Multiplexers, Data acquisition, Introduction to Digital system. Processing Pulse-modulation.

UNIT – 3**12 Hours.**

Introduction to Microprocessors: Evolution of Microprocessor, Organization of Microprocessors (Preliminary concepts), basic concepts of programming of microprocessors. Review of concepts - Boolean algebra, Logic Gates and Gate Networks, Binary & Decimal number systems, memory representation of positive and negative integers, maximum and minimum integers. Conversion of real, numbers, floating point notation, representation of floating point numbers, accuracy and range in floating point representation, overflow and underflow, addition of floating point numbers, character representation.

UNIT – 4**12 Hours.**

Logic Function: Data word representation. Basic elements of control systems 808SA processor architecture terminology such as CPU, memory and address, ALU, assembler data registers, Fetch cycle, write cycle, state, bus, interrupts. Micro Controllers. Difference between microprocessor and micro controllers. Requirements for control and their implementation in microcontrollers. Classification of micro controllers.

UNIT – 5

Organization & Programming of Microprocessors: Introduction to organization of INTEL 808S-Data and Address buses, Instruction set of 8085, programming the 8085, assembly language programming.

Central Processing Unit of Microprocessors: Introduction, timing and control unit basic concepts, Instruction and data flow, system timing, examples of INTEL 8085 and INTEL 4004 register organization.

ESSENTIAL READING:

1. Mechatronics, W.Bolton, Longman, 2Ed, Pearson Publications, 2007.
2. Microprocessor Architecture, Programming And Applications With 8085/8085A, R.S. Ganokar, Wiley Eastern.

RECOMMENDED READING:

1. Mechatronics and Microprocessors, K.P.Ramchandran, G.K.Vijayraghavan, M.S.Balasundran, Wiley, 1st Ed, 2009
2. Mechatronics - Principles, Concepts and applications – Nitaigour and Premchand Mahilik - Tata McGraw Hill- 2003.
3. Mechatronics Principles & applications, Godfrey C. Onwubolu, Elsevier. .
4. Introduction Mechatronics & Measurement systems, David.G. Aliciatore & Michael. B. Bihistaned, Tata McGraw Hill, 2000.

ME636 HYDRAULICS AND PNEUMATICS**OBJECTIVES:**

- *Upon completion of this course students will demonstrate an understanding of Hydraulic and Pneumatic principles, equipment, Seals and industries.*
- *Students will be able to identify and describe the basic operation of Hydraulic / Pneumatic systems, the various equipment used in their operation, Hydraulic / Pneumatic terms as well as actuator Sealing Device design / material strengths and weaknesses.*
- *Students will be able to troubleshoot Hydraulic/Pneumatic equipment and Seals.*

LEARNING OUTCOME:

- *Will be in position to device various circuit for hydraulic and pneumatic applications.*
- *Will be in position to develop various hydraulic and pneumatic devices.*
- *To understand and illustrate the working of various types of pumps.*
- *To understand and illustrate the working of various hydraulic and pneumatic devices.*

UNIT -1**12 Hours**

Introduction to Hydraulic Power: Definition of hydraulic system, advantages, limitations, applications, Pascal's law, structure of hydraulic control system, problems on Pascal's law.

The source of Hydraulic Power: Pumps Classification pumps, Pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump Selection factors, problems on pumps.

Hydraulic Actuators and Motors: Classification cylinder and hydraulic motors, Linear Hydraulic Actuators [cylinders], single and double acting cylinder, Mechanics of Hydraulic Cylinder Loading, mounting arrangements, cushioning, special types of cylinders, problems on cylinders, construction and working of rotary actuators such as gear, vane, piston motors, Hydraulic Motor Theoretical Torque, Power and Flow Rate, Hydraulic Motor Performance, problems, symbolic representation of hydraulic actuators (cylinders and motors).

UNIT-2**12 Hours**

Control Components in Hydraulic Systems: Classification of control valves, Directional Control Valves- Symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, check valves, Pressure control valves - types, direct operated types and pilot operated types. Flow Control Valves - compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation.

Hydraulic Circuit Design And Analysis: Control of Single and Double Acting Hydraulic Cylinder, Regenerative circuit, Pump Unloading Circuit, Double Pump Hydraulic System, Counter balance Valve Application, Hydraulic Cylinder Sequencing Circuits, Automatic cylinder reciprocating system, Locked Cylinder using Pilot check Valve, Cylinder synchronizing circuit using different methods, factors affecting synchronization, Hydraulic circuit for force multiplication, Speed Control of Hydraulic Cylinder, Speed Control of Hydraulic Motors, Safety circuit, Accumulators, types, construction and applications with circuits.

UNIT - 3**12 Hours**

Maintenance of Hydraulic System: Hydraulic Oils - Desirable properties, general type of Fluids, Sealing Devices, Reservoir System, Filters and Strainers, wear of Moving Parts due to solid -particle Contamination, temperature control (heat exchangers), Pressure switches, trouble shooting.

Introduction to Pneumatic Control: Definition of pneumatic system, advantages, limitations, applications, Choice of working medium. Characteristic of compressed air. Structure of Pneumatic control System, fluid conditioners and FRL unit.

Pneumatic Actuators: Linear cylinder - Types, Conventional type of cylinder- working, End position cushioning, seals, mounting arrangements- Applications. Rod - Less cylinders types, working, advantages, Rotary cylinders- types construction and application, symbols.

UNIT-4**12 Hours**

Pneumatic Control Valves: DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols. 3Hrs Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and Exhaust air throttling and Exhaust air throttling.

Signal Processing Elements: Use of Logic gates - OR and AND gates in pneumatic applications. Practical Examples involving the use of logic gates, Pressure dependant controls- types - construction - practical applications, Time dependent controls principle. Construction, practical applications.

UNIT- 5**12 Hours**

Multi- Cylinder Application: Coordinated and sequential motion control, Motion and control diagrams. Signal elimination methods, Cascading method- principle, Practical application examples (up to two cylinders) using cascading method (using reversing valves).

Electro- Pneumatic Control: Principles - signal input and out put, pilot assisted solenoid control of directional control valves, Use of relay and contactors. Control circuitry for simple signal cylinder application.

Compressed Air: Production of compressed air- Compressors Preparation of compressed air- Driers, Filters, Regulators, Lubricators, Distribution of compressed air Piping layout.

ESSENTIAL READINGS:

1. "Fluid Power with Applications", Anthony Esposito, Sixth edition, Pearson Education, Inc, 2000.
2. 'Pneumatics and Hydraulics', Andrew Parr, Jaico Publilishing Co

RECOMMENDED READING:

1. 'Oil Hydraulic systems', Principles and Maintenance S. R. Majurr, Tata Mc Graw Hill Publishing Company Ltd. - 2001
2. 'Industrial Hydraulics', Pippenger, Hicks" McGraw Hill, New York
3. 'Hydraulic & Pneumatic Power for Production', Harry L. Stewart
4. 'Pneumatic Systems', S. R. Majumdar, Tata Mc Graw Hill Publish 1995
5. Power Hydraulics' Michael J Pinches & John G Ashby, Prentice Hall

ME651 HEAT & MASS TRANSFER LABORATORY

PAPER DESCRIPTION: *Provides working knowledge of heat & mass transfer engineering.*

PAPER OBJECTIVE:

- *To develop skills in the field of heat & mass transfer engineering.*
- *Verify the principles of the course,Application of the theory , Understanding of fundamentals of the subject.*
- *Be in a position to relate theory and practice,*

Level of knowledge: *Working.*

SUBJECT DESCRIPTION:

This Laboratory has various experiments that aims at enabling the students to learn the concepts of heat & mass transfer engineering.

OUTCOME:

- *Will be able to apply the concepts of heat & mass transfer engineering, appreciate its application in various engineering application.*
- *Will be able to perform various test of heat & mass transfer engineering for various mechanical properties.*
- *Will be able to carry out performance tests on heat & mass transfer engineering.*
- *To develop scientific, technical and experimental skills to the students.*
- *To correlate the theoretical principles with application based studies.*

PART - A

1. Determination of Thermal Conductivity of a Metal Rod.
2. Determination of Overall Heat Transfer Coefficient of a Composite wall.
3. Determination of Effectiveness on a Metallic fin.
4. Determination of Heat Transfer Coefficient in a free Convection on a vertical tube.

5. Determination of Heat Transfer Coefficient in a Forced Convection Flow through a Pipe.
6. Determination of Emissivity of a Surface.

21 Hours

PART - B

1. Determination of Stefan Boltzman Constant.
2. Determination of LMDT and Effectiveness in a Parallel Flow and Counter Flow Heat Exchangers
3. Experiments on Boiling of Liquid and Condensation of Vapour
4. Performance Test on a Vapour Compression Refrigeration.
5. Performance Test on a Vapour Compression Air - Conditioner
6. Experiment on Transient Conduction Heat Transfer

21 Hours

ME652 COMPUTER AIDED MODELING AND ANALYSIS LABORATORY

PAPER DESCRIPTION: *Provides working knowledge of computer aided modeling and analysis.*

PAPER OBJECTIVE:

- *To develop skills in the field of computer aided modeling and analysis.*
- *Verify the principles of the course, Application of the theory, Understanding of fundamentals of the subject.*
- *Be in a position to relate theory and practice,*

Level of knowledge: *Working.*

SUBJECT DESCRIPTION:

- *This Laboratory has various experiments that aims at enabling the students to learn the concepts of computer aided modeling and analysis.*

LEARNING OUTCOME:

- *Will be able to apply the concepts of computer aided modeling and analysis engineering, appreciate its application in various engineering application.*
- *Will be able to perform various computer modeling and analysis for various mechanical elements.*
- *Will be able to carry out computer aided analysis.*
 - *To develop scientific, technical and experimental skills to the students.*
 - *To correlate the theoretical principles with application based studies.*

PART - A**Study of a FEA package and modeling stress analysis of**

1. Bars of constant cross section area, tapered cross section area and stepped bar

6 Hours

2. Trusses – (Minimum 2 exercises)

3Hours

3. Beams – Simply supported, cantilever, beams with UDL, beams with varying load etc
(Minimum 6 exercises)

12 Hours

PART - B

4. Stress analysis of a rectangular plate with a circular hole **3 Hours**
5. Thermal Analysis – 1D & 2D problem with conduction and convection boundary conditions(Minimum 4 exercises) **9 Hours**
6. Dynamic Analysis
 5. Fixed – fixed beam for natural frequency determination
 6. Bar subjected to forcing function
 7. Fixed – fixed beam subjected to forcing function

9 Hours

RECOMMENDED READING:

1. A first course in the Finite element method, Daryl L Logan, Thomason, Third Edition
2. Fundamentals of FEM, Hutton – McGraw Hill, 2004
3. Finite Element Analysis, George R. Buchanan, Schaum SerSEMESTER VII

SEMESTER VII**ME731 ENGINEERING ECONOMY****OBJECTIVES:**

- *PREPARE ENGINEERING STUDENTS TO ANALYZE COST/REVENUE DATA AND CARRY OUT MAKE ECONOMIC ANALYSES IN THE DECISION MAKING PROCESS TO JUSTIFY OR REJECT ALTERNATIVES/PROJECTS ON AN ECONOMIC BASIS.*
- *BE ABLE TO PERFORM AND EVALUATE PRESENT WORTH, FUTURE WORTH AND ANNUAL WORTH ANALYSES ON ONE OF MORE ECONOMIC ALTERNATIVES.*
- *BE ABLE TO PERFORM AND EVALUATE PAYBACK PERIOD AND CAPITALIZED COST ON ONE OR MORE ECONOMIC ALTERNATIVES.*
- *BE ABLE TO CARRY OUT AND EVALUATE BENEFIT/COST, LIFE CYCLE AND BREAK EVEN ANALYSES ON ONE OR MORE ECONOMIC ALTERNATIVES.*

LEARNING OUTCOME:

- *Student will be competent to do budget, balance sheet, strategy for industrial needs.*
- *Acquire knowledge to evaluate and explain financial planning.*
- *Will learn strategies to evaluate strategies for running the industry in profit despite adverse financial market*
- *Will be in a position to Carry out work strategy, analyse balance sheet and profit and loss accounts.*

UNIT – 1**13 Hours**

INTRODUCTION: Engineering Decision-Makers, Engineering and Economics, Problem solving and Decision making, Intuition and Analysis, Tactics and Strategy. Engineering Economic Decision, Maze. Law of demand and supply, Law of returns, Interest and Interest factors: Interest rate, Simple interest, Compound interest, Cash - flow diagrams, Personal loans and EMI Payment, Exercises and Discussion.

PRESENT-WORTH COMPARISONS: Conditions for present worth comparisons, Basic Present worth comparisons, Present-worth equivalence, Net Present-worth, Assets with unequal lives, infinite lives, Future-worth comparison, Pay-back comparison, Exercises, Discussions and problems.

UNIT – 2**13 Hours**

EQUIVALENT ANNUAL-WORTH COMPARISONS: Equivalent Annual-Worth Comparison methods, Situations for Equivalent Annual-Worth Comparisons, Consideration of asset life, Comparison of assets with equal and unequal lives, Use of shrinking fund method, Annuity contract for guaranteed income, Exercises, Problems.

RATE-OF-RETURN CALCULATIONS AND DEPRECIATION: Rate of return, Minimum acceptable rate of return, IRR, IRR misconceptions, Cost of capital concepts. Causes of Depreciation, Basic methods of computing depreciation charges, Tax concepts, corporate income tax.

UNIT – 3**11 Hours**

Estimating and Costing: Components of costs such as Direct Material Costs, Direct Labor Costs, Fixed Over-Heads, Factory cost, Administrative Over-Heads, First cost, Marginal cost, Selling price, Estimation for simple components.

UNIT – 4**11 Hours**

INTRODUCTION, SCOPE OF FINANCE, FINANCE FUNCTIONS: Statements of Financial Information: Introduction, Source of financial information, Financial statements, Balance sheet, Profit and Loss account, relation between Balance sheet and Profit and Loss account. Simple Numericals

UNIT -5**12 Hours**

FINANCIAL RATIO ANALYSIS: Introduction, Nature of ratio analysis, Liquidity ratios, Leverage ratios, Activity ratios, Profitability ratios, Evaluation of a firm's earning power. Comparative statements analysis. Simple numericals

FINANCIAL AND PROFIT PLANNING: Introduction, Financial planning, Profit planning, Objectives of profit planning, Essentials of profit planning, Budget administration, type of budgets, preparation of budgets, advantages, problems and dangers of budgeting. Introduction to Bench Marking of Manufacturing Operation.

ESSENTIAL READINGS:

1. Engineering Economy, Riggs J.L., , McGraw Hill, 2002
2. Engineering Economy, Thuesen H.G. PHI , 2002

RECOMMENDED READING:

1. Engineering Economy, Tarachand, 2000.
2. Industrial Engineering and Management, OP Khanna, Dhanpat Rai & Sons. 2000
3. Financial Mangement, Prasanna Chandra, TMH, 2004
4. Finacial Management, IM PANDEY, Vikas Publisahing House, 2002

ME732 MECHANICAL VIBRATIONS**UNIT - 1****13 Hours**

Introduction: Types of vibrations, Definitions, Simple Harmonic Motion (S.H.M.), Work done by harmonic force, Principle of super position applied to SHM, Beats, Fourier theorem and problems.

Undamped (Single Degree of Freedom) Free Vibrations: Derivations for spring mass systems, Methods of Analysis, Natural frequencies of simple systems, Springs in series and parallel, Torsional and transverse vibrations, Effect of mass of spring and Problems.

UNIT - 2**13 Hours**

Damped free vibrations (1DOF): Types of damping, Analysis with viscous damping - Derivations for over, critical and under damped systems, Logarithmic decrement and Problems.

Forced Vibrations (1DOF): Introduction, Analysis of forced vibration with constant harmonic excitation - magnification factor, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, Energy dissipated due to damping and Problems.

UNIT -3**11 Hours**

Vibration Measuring Instruments and Whirling of shafts: Seismic Instruments – Vibrometers, Accelerometer, Frequency measuring instruments and Problems. Whirling of shafts with and without damping, discussion of speeds above and below critical speeds and Problems.

Systems with two degrees of Freedom: Principle modes of vibrations, Normal mode and natural frequencies of systems (without damping) – Simple spring mass systems, masses on tightly stretched strings, double pendulum, torsional systems, combined rectilinear and angular systems, geared systems and Problems. Undamped dynamic vibration absorber and Problems.

UNIT – 4**13 Hours**

Numerical Methods for multi degree freedom of systems: Introduction, Maxwell's reciprocal theorem, Influence coefficients, Rayleigh's method, Dunkerley's method, Stodola method, Holzer's method, Orthogonality of principal modes, method of matrix iteration and Problems.

UNIT-5**11 Hours**

Modal analysis and Condition Monitoring: Signal analysis, dynamic testing of machines and structures, Experimental modal analysis, Machine condition monitoring and diagnosis.

ESSENTIAL READING:

1. Mechanical Vibrations, S. S. Rao, Pearson Education Inc, 4th edition, 2003.
2. Mechanical Vibrations, V. P. Singh, Dhanpat Rai & Company, 3rd edition, 2006.

RECOMMENDED READING:

1. Theory of Vibration with Applications, W. T. Thomson, M. D. Dahleh and C. Padmanabhan, Pearson Education Inc, 5th edition, 2008.
2. Mechanical Vibrations: S. Graham Kelly, Schaum's outline Series, Tata McGraw Hill, Special Indian Edition, 2007.
3. Theory and Practice of Mechanical Vibrations: J. S. Rao & K. Gupta, New Age International Publications, New Delhi, 2001.
4. Mechanical Vibrations, G. K. Grover, Nem Chand and Bros, 6th edition, 1996.

ME733 OPERATIONS RESEARCH**OBJECTIVES:**

- *One or more advanced courses on applications in: supply chain and manufacturing systems; data analysis; information engineering; financial engineering; or service systems.*
- *A collaborative systems design experience.*
- *Collaborative project experiences involving both written and oral presentations.*
- *Courses with significant experiential learning components.*
- *Experiences with identifying, accessing, evaluating, and interpreting information and data in support of assignments, projects, or research.*
- *Course experiences with large-scale datasets.*

LEARNING OUTCOME:

Upon completion of the subject, students will be able to

- *Identify and develop operational research models from the verbal description of the real system.*
- *Recognize the importance and value of Operations Research and mathematical modelling in solving practical problems in industry.*
- *Formulate a managerial decision problem into a mathematical model.*
- *Understand Operations Research models and apply them to real-life problems;*
- *Use computer tools to solve a mathematical model for a practical problem.*
- *Develop a report that describes the model and the solving technique, analyse the results and propose recommendations in language understandable to the decision-making processes in Management Engineering*
- *Proficiency with tools from optimization, probability, statistics, simulation, and engineering economic analysis, including fundamental applications of those tools in industry and the public sector in contexts involving uncertainty and scarce or expensive resources.*

- *Facility with mathematical and computational modeling of real decision-making problems, including the use of modeling tools and computational tools, as well as analytic skills to evaluate the problems.*
- *Facility with the design, implementation, and analysis of computational experiments.*

UNIT -1**12 Hours**

INTRODUCTION: Evolution of OR, definition of OR, scope of OR, application areas of OR, steps (phases) in OR study, characteristics and limitations of OR, models used in OR, linear programming (LP) problem-formulation and solution by graphical method.

SOLUTION OF Linear Programming PROBLEMS: The simplex method-canonical and standard form of an LP problem, slack, surplus and artificial variables, big M method and concept of duality, dual simplex method.

UNIT -2**12 Hours**

TRANSPORTATION PROBLEM: Formulation of transportation problem, types, initial basic feasible solution using different methods, optimal solution by MODI method, degeneracy in transportation problems, application of transportation problem concept for maximization cases. Assignment Problem-formulation, types, application to maximization cases and travelling salesman problem.

UNIT -3**12 Hours**

PERT-CPM TECHNIQUES: Introduction, network construction - rules, Fulkerson's rule for numbering the events, AON and AOA diagrams; Critical path method to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects.

UNIT-4

11HOURSHOURQUEUING THEORY: Queuing systems and their characteristics, Pure-birth

and Pure-death models (only equations), empirical queuing models – M/M/1 and M/M/C models and their steady state performance analysis.

UNIT -5**13 Hours**

GAME THEORY: Formulation of games, types, solution of games with saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games.

SEQUENCING: Basic assumptions, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing 2 jobs on 'm' machines using graphical method.

ESSENTIAL READINGS

1. Operations Research, P K Gupta and D S Hira, Chand Publications, New Delhi - 2007
2. Operations Research, Taha H A, Pearson Education

REFERNCE BOOKS

1. Operations Research, A P Verma, S K Kataria & Sons, 2008
2. Operations Research, Paneerselvan, PHI
3. Operations Research, A M Natarajan, P Balasubramani, Pearson Education, 2005
4. Introduction to Operations Research, Hiller and Liberman, McGraw Hill
5. Operations Research S.D. Sharma, Ledarnath Ramanath & Co, 2002

ME734 INDUSTRIAL ROBOTICS**OBJECTIVES:**

- *To give an overview of the components, sensing elements used programming techniques and applications of robots.*
- *Identify the characteristics of a variety of types and sizes of robots.*
- *Describe how artificial intelligence is applied to robotic systems When? How?*
- *Identify, sketch and label all major parts of an industrial robot.*
- *Describe the basic components that allow an operator to program robots.*
- *Compare and contrast robotic applications in medicine, industrial, and entertainment applications.*
- *Set up and program an interactive robotics station*
- *Identify and describe the preparation and requirements for careers related to robotics.*

LEARNING OUTCOME:

- *The study includes mathematical formulation for a robot body.*
- *Know the movement of robot arm based on there translation or rotational moment.*
- *Selection of particular sensors for different robot application.*
- *Designing a robot with widest range of applications for current and future products with minimum cost using suitable actuators, sensors etc.*

UNIT – 1

Introduction and Mathematical Representation of Robots: History of Robots, Types of Robots, Notation, Position and Orientation of a Rigid Body, Some Properties of Rotation Matrices, Successive Rotations, Euler Angles For fixed frames X- Y -Z and moving frame ZYZ. Transformation between coordinate system, Homogeneous coordinates, Properties of A/BT, Types of Joints: Rotary, Prismatic joint, Cylindrical joint, Spherical joint, Representation of Links using Denvit - Hartenberg Parameters: Link parameters for intermediate, first and last links, Link transformation matrices, Transformation matrices of 3R manipulator, PUMA560 manipulator, SCARA manipulator

UNIT - 2

Kinematics of Serial Manipulators: Direct kinematics of 2R, 3R, RRP, RPR manipulator, puma560 manipulator, SCARA manipulator, Stanford arm, Inverse kinematics of 2R, 3R manipulator, puma560 manipulator.

Velocity and Static's of Manipulators: Differential relationships, Jacobian, Differential motions of a frame (translation and rotation), Linear and angular velocity of a rigid body, Linear and angular velocities of links in serial manipulators, 2R, 3R manipulators, Jacobian of serial manipulator, Velocity ellipse of 2R manipulator, Singularities of 2R manipulators, Statics of serial manipulators, Static force and torque analysis of 3R manipulator, Singularity in force domain.

UNIT - 3

Dynamics of Manipulators: Kinetic energy, Potential energy, Equation of motion using Lagrangian, Equation of motions of one and two degree freedom spring mass damper systems using Lagrangian formulation, Inertia of a link, Recursive formulation of Dynamics using Newton Euler equation, Equation of motion of 2R manipulator using Lagrangian Newton-Euler formulation.

UNIT - 4

Trajectory Planning: Joint space schemes, cubic trajectory, Joint space schemes with via points, Cubic trajectory with a via point, Third order polynomial trajectory planning, Linear segments with parabolic blends, Cartesian space schemes, Cartesian straight line and circular motion planning

Sensors: Sensor characteristics, Position sensors- potentiometers, Encoders, LVDT, Resolvers, Displacement sensor, Velocity sensor-encoders, tachometers, Acceleration sensors, Force and Pressure sensors piezoelectric, force sensing resistor, Torque sensors, Touch and tactile sensor, Proximity sensors-magnetic, optical, ultrasonic, inductive, capacitive, eddy-current proximity sensors.

UNIT - 5

Control: Feedback control of a single link manipulator- first order, second order system, PID control, PID control of multi link manipulator, Force control of manipulator, force control of single mass, Partitioning a task for force and position control- lever, peg in hole Hybrid force and position controller.

Actuators: Types, Characteristics of actuating system: weight, power-to-weight ratio, operating pressure, stiffness vs. compliance, Use of reduction gears, comparison of hydraulic, electric, pneumatic actuators, Hydraulic actuators, proportional feedback control, Electric motors: DC motors, Reversible AC motors, Brushless DC motors, Stepper motors- structure and principle of operation, stepper motor speed-torque characteristics

ESSENTIAL READINGS:

1. Fundamental Concepts and Analysis, Ghosal A., Robotics, Oxford,2006
2. Introduction to Robotics Analysis, Systems, Applications, Niku, S. B., Pearson Education, 2008

RECOMMENDED READING:

1. Introduction to Robotics: Mechanics and Control, Craig, J. J., 2nd Edition, Addison-Wiley, 1989.
2. Fundamentals of Robotics, Analysis and Control, Schilling R. J., PHI, 2006

ME751 DESIGN LABORATORY

PAPER DESCRIPTION: *Provides working knowledge of design Engineering.*

PAPER OBJECTIVE:

- *To develop skills in the field of design Engineering.*
- *Verify the principles of the course, Application of the theory, Understanding of fundamentals of the subject design Engineering.*
- *Be in a position to relate theory and practice,*

Level of knowledge: *Working.*

SUBJECT DESCRIPTION:

This Laboratory has various experiments that aims at enabling the students to learn the concepts of design Engineering.

LEARNING OUTCOME:

- *Will be able to apply the concepts of design Engineering, appreciate its application in various engineering application.*
- *Will be able to perform design engineering experiments for various mechanical elements.*
- *To develop scientific, technical and experimental skills to the students.*
- *To correlate the theoretical principles with application based studies.*

PART - A

1. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom vibrating systems (longitudinal and torsional)
2. Balancing of rotating masses.
3. Determination of critical speed of a rotating shaft.
4. Determination of Fringe constant of Photoelastic material using.
 - a. Circular disc subjected to diametral compression.
 - b. Pure bending specimen (four point bending)
5. Determination of stress concentration using Photoelasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression, 2D Crane hook.

PART - B

6. Determination of equilibrium speed, sensitiveness, power and effort of Porter/Prowel /Hartnel Governor. (only one or more)
7. Determination of Pressure distribution in Journal bearing.
8. Determination of Principal Stresses and strains in a member subjected to combined loading using Strain rosettes.
9. Determination of stresses in Curved beam using strain gauge.
10. Experiments on Gyroscope (Demonstration only)

ME752 CIM & AUTOMATION LABORATORY

PAPER DESCRIPTION: *Provides working knowledge of CIM & automation.*

PAPER OBJECTIVE:

- *To develop skills in the field of cim & automation Engineering.*
- *Verify the principles of the course, Application of the theory, Understanding of fundamentals of the subject cim & automation Engineering.*
- *Be in a position to relate theory and practice,*

Level of knowledge: *Working.*

SUBJECT DESCRIPTION:

This Laboratory has various experiments that aims at enabling the students to learn the concepts of cim & automation Engineering.

LEARNING OUTCOME:

- *Will be able to apply the concepts of cim & automation Engineering, appreciate its application in various engineering application.*
- *Will be able to perform cim & automation Engineering experiments for various mechanical elements.*
- *To develop scientific, technical and experimental skills to the students.*
- *To correlate the theoretical principles with application based studies.*

PART - A

CNC part programming using CAM packages. Simulation of Turning, Drilling, Milling operations. 3 typical simulations to be carried out using simulation packages like Master- CAM, or any equivalent software.

PART - B

(Only for Demo/Viva voce)

1. FMS (Flexible Manufacturing System): Programming of Automatic storage and Retrieval system (ASRS) and linear shuttle conveyor Interfacing CNC lathe, milling with loading unloading arm and ASRS to be carried out on simple components.

2. Robot programming: Using Teach Pendant & Offline programming to perform pick and place, stacking of objects, 2 programs.

PART - C

(Only for Demo/Viva voce)

Pneumatics and Hydraulics, Electro-Pneumatics: 3 typical experiments on Basics of these topics to be conducted.

SEMESTER VIII**ME831 OPERATIONS MANAGEMENT****OBJECTIVES:**

- *Describe what the operations function is and why it is critical to an organization's survival.*
- *Describe what a supply chain is and how it relates to a particular organization's operations function.*
- *Discuss what is meant by operations management and supply chain management.*
- *Identify some of the major operations and supply chain activities, as well as career opportunities in these areas.*
- *Make a case for studying both operations management and supply chain management.*

LEARNING OUTCOME:

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

- *Understand the role of operations management in organizations.*
- *Differentiate between strategic and tactical operations decisions.*
- *Describe the key operations management decisions faced by managers.*
- *Understand three of the most important operations management practices: Total Quality Management, Supply Chain Management, and Just-in-Time/Lean Operations.*

UNIT 1**12 Hours**

Production and Operations Management: Introduction, Functions within business organizations, the operation management function, Classification of production systems, Productivity, factors affecting productivity, contemporary issues and development

Decision Making: The decision process, characteristics of operations decisions, use of models, decision making environments, graphical linear programming, analysis and trade-offs.

UNIT 2**13 Hours**

Forecasting: Steps in forecasting process, approaches to forecasting, forecasts based on judgment and opinion, analysis of time series data, accuracy and control of forecasts, choosing a

forecasting technique, elements of a good forecast,

Capacity & Location Planning: Importance of capacity decisions, defining and measuring capacity, determinants of effective capacity, determining capacity requirement, developing capacity alternatives, evaluating alternatives, Need for location decisions, nature of locations decisions, general procedure for making locations decisions, evaluating locations decisions, facilities layout – need for layout decisions, types of processing.

UNIT 3

11 Hours

Aggregate Planning & Master Scheduling: Aggregate planning – Nature and scope of aggregate planning, strategies of aggregate planning, techniques for aggregate planning – graphical and charting techniques, mathematical techniques. The master production schedule, Master scheduling process, Master scheduling methods.

UNIT 4

12 Hours

Inventory Management: Types of Inventories, independent and dependent demand, reasons for holding inventory, objectives of inventory control, requirements for effective inventory management – information, cost, priority system. Inventory control and economic-order-quantity models.

UNIT 5

12 Hours

Material Requirement Planning (MRP): Dependent versus independent demand, an overview of MRP – MRP inputs and outputs, MRP processing, An overview of MRP-II and ERP capacity requirement planning, benefits and limitations of MRP.

Purchasing and Supply Chain Management (SCM): Introduction, Importance of purchasing and SCM, The procurement process, Concept of tenders, Approaches to SCM, Vendor development, Measures of purchasing and SCM, Make or buy decision, Types of buying, E-procurement.

ESSENTIAL READING:

1. Production and Operations Management, William J Stevenson, Tata McGraw Hill, 8th Edition.
2. Operations Management-Theory and Practice, B Mahadevan, Pearson Education, 2007.

RECOMMENDED READING:

1. Production and Operations Management, Norman Gaither & Greg Frazier,
2. Operations Management for Competitive Advantage, R.B.Chase, N.J.Aquilino, F. Roberts Jacob; McGraw Hill Companies Inc., Ninth Edition.
3. Production & Operations Management, Everett E.Adams, Ronald J.Ebert, Prentice Hall of India Publications, Fourth Edition.
4. Production / Operations Management, Joseph G Monks, McGraw Hill Books

ME832 CONTROL ENGINEERING**OBJECTIVES:**

- *A control system consisting of interconnected components is designed to achieve a desired purpose. To understand the purpose of a control system, it is useful to examine examples of control systems through the course of history. These early systems incorporated many of the same ideas of feedback that are in use today.*
- *Modern control engineering practice includes the use of control design strategies for improving manufacturing processes, the efficiency of energy use, advanced automobile control, including rapid transit, among others.*
- *We also discuss the notion of a design gap. The gap exists between the complex physical system under investigation and the model used in the control system synthesis.*
- *The iterative nature of design allows us to handle the design gap effectively while accomplishing necessary trade-offs in complexity, performance, and cost in order to meet the design specifications.*

UNIT – 1**13 Hours**

Introduction: Concept of automatic controls, Open loop and closed loop systems, Concepts of feedback, requirements of an ideal control system, Types of controllers- Proportional, Integral Proportional Integral, Proportional Integral Differential controllers. **Mathematical Models:** Transfer function models, models of mechanical systems, models of electrical circuits, DC and AC motors in control systems, models of thermal systems, models of hydraulic systems, pneumatic system, Analogous systems: Force voltage, Force current.

UNIT – 2**13 Hours**

Block Diagrams and Signal Flow Graphs: Transfer Functions definition, function, block representation of systems elements, reduction of block diagrams, Signal flow graphs: Mason's gain formula.

Transient and Steady State Response Analysis: Introduction, first order and second order system response to step, ramp and impulse inputs, concepts of time constant and its importance in speed of response. System stability: Routh's-Hurwitz Criterion.

UNIT – 3**11 Hours**

Frequency Response Analysis: Polar plots, Nyquist stability criterion, Stability analysis, Relative stability concepts, Gain margin and phase margin, M&N circles. **Frequency Response Analysis Using Bode Plots:** Bode attenuation diagrams, Stability analysis using Bode plots, Simplified Bode Diagrams.

UNIT – 4**12 Hours**

Root Locus Plots: Definition of root loci, General rules for constructing root loci, Analysis using root locus plots.

UNIT- 5**11 Hours**

System Compensation and State Variable Characteristics of Linear Systems: Series and feedback compensation, Introduction to state concepts, state equation of linear continuous data system. Matrix representation of state equations, controllability and observability, Kalman and Gilberts test.

ESSENTIAL READING :

1. Modern Control Engineering, Katsuhiko Ogatta, Pearson Education,2004.
2. Control Systems Principles and Design, M.Gopal, TMH,2000.

RECOMMENDED READING:

1. Modern Control Systems, Richard.C.Dorf and Robert.H.Bishop, Addison Wesley,1999
2. System dynamics & control, Eronini-Umez, Thomson Asia pte Ltd. singapore, 2002.
3. Feedback Control System, Schaum's series. 2001.

ELECTIVE-I (ME635)

ME635 THEORY OF ELASTICITY

OBJECTIVES:

- *Be able to analyze some real problem and to formulate the conditions of theory of elasticity application*
- *Be able to execute a reasonable choice of parameters of the model (geometry, material properties, boundary conditions)*
- *Be able to analyze the result of solution by standard computational programs.*

LEARNING OUTCOMES:

- *To be able to execute the stress state and stresses analysis Topic of Work: The stresses state analysis.*
- *To be able to solve a problem of strain analysis Topic of Work: The strain state analysis.*
- *To be able to use the numerical methods for the problem of the theory of elasticity in practice.*
- *To be able to use theory for solution of practice problem of stress and strain analysis Final examination.*

UNIT – 1

13 Hours

DEFINITION AND NOTATION: Stress, Stress at a Point, Equilibrium Equations, Principal Stresses, Mohr's Diagram, Maximum Shear Stress, Boundary Conditions.

STRAIN AT A POINT: Compatibility Equations, Principal Strains, Generalised Hooke's law, Methods of Solution of Elasticity Problems – Plane Stress-Plane Strain Problems.

UNIT – 2

11 Hours

TWO DIMENSIONAL PROBLEMS: Cartesian co-ordinates – Airy's stress functions – Investigation of Airy's Stress function for simple beam problems – Bending of a narrow cantilever beam of rectangular cross section under edge load – method of Fourier analysis – pin ended beam under uniform pressure.

UNIT – 3**13 Hours**

GENERAL EQUATIONS IN CYLINDRICAL CO-ORDINATES: Thick cylinder under uniform internal and / or external pressure, shrink and force fit, stress concentration.

STRESSES IN AN INFINITE PLATE (with a circular hole) subjected to uniaxial and biaxial loads, stress concentration, stresses in rotating discs and cylinders.

UNIT – 4**11 Hours**

TORSION OF CIRCULAR, ELLIPTICAL AND TRIANGULAR BARS: membrane analogy, torsion of thin open sections and thin tubes.

UNIT – 5**11 Hours**

THERMAL STRESSES: Thermo elastic stress strain relationship, Equations of equilibrium Thermal stresses in thin circular discs and in long circular cylinder, sphere.

UNIQUENESS THEOREM: Principle of super position, reciprocal theorem, saint venant principle.

ESSENTIAL READINGS:

1. Advanced Mechanics of solids, L. S. Srinath, Tata Mc. Graw Hill, 2003
2. Theory of Elasticity, S. P. Timoshenko and J. N Gordier, Mc.Graw Hill International, 3rd edition, 1972

RECOMMENDED READINGS:

1. Theory of Elasticity, Dr. Sadhu Singh, Khanna Publications, 1988
1. Elasticity, Theory, Applications & Numericals, Martin H Sadd, Elsevier. 2005
3. Applied Elasticity, Seetharamu & Govindaraju, Interline Publishing
4. Applied Elasticity, C.T. WANG Sc. D. Mc. Graw Hill Book Co.1953

ME635 MECHANICS OF COMPOSITE MATERIALS**OBJECTIVES:**

- An ability to identify the properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.
- An ability to predict the elastic properties of both long and short fiber composites based on the constituent properties.
- An ability to rotate stress, strain and stiffness tensors using ideas from matrix algebra.

OUTCOME:

- To explain the overview of materials.
- To describe the attributes of Materials.

UNIT – 1**13 Hours.**

INTRODUCTION TO COMPOSITE MATERIALS: Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites.

APPLICATIONS: Automobile, Aircrafts, missiles, Space hardware, Electrical and electronics, Marine, recreational and sports equipment, future potential of composites.

FIBER REINFORCED PLASTIC PROCESSING: Lay up and curing, fabricating process, open and closed mould process, hand lay up techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermoforming, injection molding, blow molding.

UNIT – 2**11 Hours.**

Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elastic moduli by Rule of mixture, Numerical problems. **Macro Mechanics of a Lamina:** Hooke's law for different types of materials, Number of elastic constants, Two - dimensional relationship of compliance and stiffness matrix.

UNIT – 3**12 Hours.**

Macro Mechanics of a Lamina Hooke's law for two-dimensional angle lamina, engineering constants - Numerical problems. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems.

Biaxial Strength Theories: Maximum stress theory, Maximum strain theory, Tsai-Hill theory, Tsai, Wu tensor theory, Numerical problems.

UNIT – 4**13 Hours**

Macro Mechanical Analysis of Laminate: Introduction, code, Kirchoff hypothesis, CL T, A, B, and D matrices (Detailed derivation) ,Special cases of laminates, Numerical problems

METAL MATRIX COMPOSITES: Reinforcement materials, types, characteristics and selection base metals selection. Need for production MMC's and its application.

FABRICATION PROCESS FOR MMC'S: Powder metallurgy technique,liquid metallurgy technique and secondary processing, special fabrication techniques.

UNIT – 5**11 Hours.**

STUDY PROPERTIES OF MMC'S: Physical Mechanical, Wear, machinability and Other Properties. Effect of size, shape and distribution of particulate on properties.

ESSENTIAL READINGS:

1. Composite Science and Engineering, K. K. Chawla Springer Verlag 1998.
2. Mechanics of composite materials, Autar K. Kaw CRC Press New York.

RECOMMENDED READING:

1. Fiber Reinforced Composites, P. K. Mallick, Marcel Dekker,Inc
2. Mechanics of Composite Materials, Robert M. Jones, McGraw Hill Kogakusha Ltd.1998
3. Composite materials hand book, Meing Schwaitz,” McGraw Hill book company.1984
4. Principles of composite Material mechanics, Ronald F. Gibron. McGraw Hill international, 1994.
5. Mechanics of Composite Materials and Structures, Madhujit Mukhopadhyay , University Press 2009

ME635 REFRIGERATION AND AIR CONDITIONING**OBJECTIVES:**

- *To know what is refrigeration and air-conditioning,*
- *To know the history of refrigeration,*
- *To know applications of refrigeration and air-conditioning, and*
- *To describe the term ton of refrigeration and COP.*

LEARNING OUTCOME:

- *To be able to explain different processes of refrigeration*
- *To compare different refrigeration cycles*
- *To estimate performance parameters of different refrigeration cycles*
- *To describe different psychrometric processes*
- *To be able to use psychrometric chart and make cooling requirement calculations*
- *To be able to design winter/summer/round the year air-conditioning system*

Note: pre requisite Applied Thermodynamics

UNIT – 1**12 Hours**

METHODS OF REFRIGERATION: Ice refrigeration, evaporative refrigeration, air refrigeration, vapour refrigeration, dry ice refrigeration, thermo electric refrigeration, pulse tube refrigeration, thermoacoustic refrigeration.

GAS CYCLE REFRIGERATION: Introduction , reverse Carnot cycle, Bell Coleman cycle, advantages & dis-advantages of gas refrigeration system. Applications to aircraft refrigeration, Analysis of gas refrigeration and Numericals.

UNIT – 2**12 Hours**

MULTI PRESSURE VAPOUR COMPRESSION SYSTEMS: Multi stage compression, Multi evaporator systems, Cascade systems, calculation, production of solid carbon dioxide, System practices for multistage system.

UNIT – 3**12 Hours**

REFRIGERANTS: Types of Refrigerants, Comparative study of Ethane and Methane derivatives, selection of Refrigerants, Requirements of Refrigerants, Effects of lubricants in Refrigerants, substitutes of CFC Refrigerants, Mixture Refrigerants-azeotropic mixtures

EQUIPMENTS USED IN VAPOUR COMPRESSION REFRIGERATION SYSTEM:

Compressors: Principle, types of compressors, capacity control. Condensers: Types and construction, Expansion devices: Types- Automatic expansion valve, Thermostatic expansion valves, capillary tube. Sizing Evaporator: Types & construction.

UNIT-4**12 Hours**

VAPOUR ABSORPTION SYSTEM: Common refrigerant absorbent combinations, Binary mixtures, Ammonia Water Absorption system, Actual vapour absorption cycle and its representation on enthalpy. composition diagram, calculations. Triple fluid vapour absorption refrigeration system. Water - Lithium Bromide absorption chiller.

DESIGN CONDITIONS: Outside design conditions, choice of inside conditions, comfort chart. Choice of supply design condition.

UNIT – 5**12 Hours**

LOAD CALCULATIONS AND APPLIED PSYCHOMETRICS: Internal heat gains, system heat gains, break up of ventilation load and effective sensible heat factor, Bypass factor, cooling load estimate. Psychometric calculations for cooling. Selection of Air conditioning apparatus for cooling and dehumidification, evaporative cooling.

TRANSMISSION AND DISTRIBUTION OF AIR: Room Air Distribution, Friction loss in ducts, dynamic losses in ducts, Air flow through simple Duct system, Duct design.

ESSENTIAL READINGS:

1. 'Refrigeration and Air-Conditioning' C. P. Arora, Tata McGraw Hill Publication, 2nd edition, 2001.
2. 'Refrigeration and Air-Conditioning' W. F. Stoecker, Tata McGraw Hill Publication, 2nd edition, 1982.

RECOMMENDED READING:

1. 'Principles of Refrigeration' Dossat, Pearson-2006.
2. 'Heating, Ventilation and Air Conditioning', McQuiston, Wiley Students edition, 5th edition 2000.
3. 'Air conditioning' PITA, 4th edition, pearson-2005
4. 'Refrigeration and Air-Conditioning' Manohar prasad
5. 'Refrigeration and Air-Conditioning' S C Arora & S Domkundwar, Dhanpat Rai Publication

ME635 DESIGN OF HEAT EXCHANGER**UNIT – 1****12 Hours**

INTRODUCTION TO HEAT EXCHANGER DESIGN: Types of heat exchangers and their applications. Flow arrangements and temperature distributions in transfer type of heat exchangers. Overall heat transfer coefficient;- Clean overall heat transfer coefficient, dirt factor dirt overall heat transfer coefficient, dirt factors for various process services. Basic design equation. Mean temperature difference Concept: - LMTD for parallel flow and counter flow arrangement, correction factor for LMTD for cross flow and multi – pass heat exchangers.

SHELL AND TUBE HEAT EXCHANGERS: Constructional features. Applications. Effectiveness-NTU method for heat exchanger design/ analysis. Rating and sizing problem. Correlations for tube side pressure drop and heat transfer coefficients. Pressure drop and heat transfer coefficient correlations for shell side flow.

UNIT – 2**11 Hours**

EFFECT OF BY – PASS AND LEAKAGE CALCULATION PROCEDURE FOR SHELL AND TUBE HEAT EXCHANGER: Heat balance equations: LMTD: reference temperature calculations: evaluation of fluid properties: flow assignments: tube side flow area calculations; viscosity correction factor, shell side equivalent diameter, calculation of shell side heat transfer coefficient, evaluation for wall temperature, evaluation of overall heat transfer coefficient, Calculation of surface area. Calculations of tube side and shell side pressure drops.

UNIT – 3**13 Hours**

STEAM CONDENSERS: Specifications of other details as per TEMA standards. Flow arrangement for increased heat recovery: - lack of heat recovery in 1-2 exchangers true temperature difference in a 2-4 exchanger. Calculation procedure for steam condensers.

DOUBLE PIPE HEAT EXCHANGERS: Constructional features. Applications. Design parameters :- tube side and shell side film coefficients cut and twist factor, fin efficiency, overall heat transfer coefficient, mean temperature difference, available surface area, fin geometry fin

height, number of fins, tube side and shell side pressure drop. Calculation procedure for the design/ analysis of double pipe heat exchange.

UNIT – 4**12 Hours**

COMPACT HEAT EXCHANGERS: Introduction; definition of Geometric Terms: plate fin surface geometries and surface performance data; correlation of heat transfer and friction data; Goodness factor comparisons; specification of rating and sizing problems; calculation procedure for a rating problem.

AIR-COOLED HEAT EXCHANGERS: Air as coolant for industrial processes; custom-built units; fin-tube systems for air coolers; fin-tube bundles; thermal rating; tube side flow arrangements; cooling air supply by fans; cooling air supply in natural draft towers.

UNIT – 5**11 Hours.**

FURNACES AND COMBUSTION CHAMBERS: Introduction; process heaters and boiler; heat transfer in furnaces: - Heat source; Heat sink; refractory surfaces; heat transfer to the sink; Design methods: - Method of Lobo and Evans; Method of Wilson, Lobo and Hottel; The Orrok-Hudson equation; Wallenberg simplified method.

ESSENTIAL READINGS:

1. Process Heat Transfer: Donald Q. Kern, Tata McGraw –Hill Edition (1997)
2. Compact Heat Exchangers: W. M. Kays & A. L. London, McGraw –Hill co. (1997)

RECOMMENDED READING:

1. Heat Transfer – A Basic Approach: Necati Ozsisik, McGraw – Hill International edition (1985).
2. Heat Exchanger Design Hand Book: Volumes 2 and 3, edited by Ernst U schlunder. et. al Hemisphere Publishing Co. (1983)
3. Heat exchanger- Kokac Thermal- hydraulic and design analysis.

ME635 NON-TRADITIONAL MACHINING**OBJECTIVES:**

- *Introduction of modern machining methods and their difference with conventional machining methods,*
- *Different classification criteria of modern machining methods and their classifications,*
- *Working principle, process details, applications and advantages and disadvantages machining.*

LEARNING OUTCOME:

Upon completion of the subject, students will be able to

- *Identify the characteristics of conventional machining and non-traditional machining*
- *Differentiate between conventional and non-traditional machining*
- *Classify different non-traditional machining processes*
- *Identify the need for non-traditional machining processes*
- *Describe the basic mechanism of material removal in various Non-traditional machining.*
- *Identify major components of various Non-traditional machines.*
- *Draw and state the working principle of various Non-traditional machining.*
- *Identify the process parameters and machining characteristics of various Non-traditional machines.*
- *Analyse the effect of process parameters on material removal rate (MRR)*
- *List the advantages, disadvantages and applications of various Non-traditional machining processes.*

UNIT – 1**13 Hours**

INTRODUCTION: History, Classification, comparison between conventional and Non-conventional machining process selection.

ULTRASONIC MACHINING (USM): Introduction, equipment, tool materials & tool size, abrasive slurry, cutting tool system design:- Effect of parameter: Effect of amplitude and frequency and vibration, Effect of abrasive grain diameter, effect of applied static load, effect of

slurry, tool & work material, USM process characteristics: Material removal rate, tool wear, Accuracy, surface finish, applications, advantages & Disadvantages of USM.

UNIT – 2**11 Hours**

ABRASIVE JET MACHINING (AJM): Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive, size of abrasive grain, velocity of the abrasive jet, mean number. abrasive particles per unit volume of the carrier gas, work material, stand off distance (SOD), nozzle design, shape of cut. Process characteristics-Material removal rate, Nozzle wear, Accuracy & surface finish. Applications, advantages & Disadvantages of AJM. Water Jet Machining: Principal, Equipment, Operation, Application, Advantages and limitations of water Jet machinery

UNIT – 3**12 Hours**

ELECTROCHEMICAL MACHINING (ECM): Introduction, study of ECM machine, elements of ECM process : Cathode tool, Anode work piece, source of DC power, Electrolyte, chemistry of the process, ECM Process characteristics – Material removal rate, Accuracy, surface finish, ECM Tooling: ECM tooling technique & example, Tool & insulation materials, Tool size Electrolyte flow arrangement, Handling of slug, Economics of ECM, Applications such as Electrochemical turning, Electrochemical Grinding, Electrochemical Honing, deburring, Advantages, Limitations.

CHEMICAL MACHINING (CHM): Introduction, elements of process, chemical blanking process : Preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, accuracy of chemical blanking, applications of chemical blanking, chemical milling (contour machining): process steps –masking, Etching, process characteristics of CHM: material removal rate, accuracy, surface finish, Hydrogen embrittlement, advantages & application of CHM.

UNIT - 4**11 Hours**

ELECTRICAL DISCHARGE MACHINING (EDM): Introduction, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control,

Electrode manufacture, Electrode wear, EDM tool design, choice of machining operation, electrode material selection, under sizing and length of electrode, machining time. Flushing; pressure flushing, suction flushing, side flushing, pulsed flushing synchronized with electrode movement, EDM process characteristics: metal removal rate, accuracy, surface finish, Heat Affected Zone. Machine tool selection, Application, EDM accessories / applications, electrical discharge grinding, Traveling wire EDM.

UNIT – 5**13 Hours**

PLASMA ARC MACHINING (PAM): Introduction, equipment, non-thermal generation of plasma, selection of gas, Mechanism of metal removal, PAM parameters, process characteristics. Safety precautions, Applications, Advantages and limitations.

LASER BEAM MACHINING (LBM): Introduction, equipment of LBM mechanism of metal removal, LBM parameters, Process characteristics, Applications, Advantages & limitations.

ELECTRON BEAM MACHINING (EBM): Principles, equipment, operations, applications, advantages and limitation of EBM.

ESSENTIAL READINGS:

1. Modern machining process, Pandey and Shan, Tata McGraw Hill 2000
2. New Technology, Bhattacharya 2000

RECOMMENDED READING:

1. Production Technology, HMT Tata McGraw Hill. 2001
2. Modern Machining Process, Aditya. 2002
3. Non-Conventional Machining, P.K.Mishra, The Institution of Engineers (India) Test book series, Narosa Publishing House – 2005.
4. Metals Handbook: Machining Volume 16, Joseph R. Davis (Editor), American Society of Metals (ASM)

ME635 PROJECT MANAGEMENT**UNIT 1****11 Hours.**

INTRODUCTION: Definition of project, characteristics of projects, understand projects, types of projects, scalability of project tools, project roles,

PROJECT SELECTION AND PRIORITIZATION – Strategic planning process, Strategic analysis, strategic objectives, portfolio alignment – identifying potential projects, methods of selecting projects, financial mode / scoring models to select projects, prioritizing projects, securing and negotiating projects.

UNIT-2**12 Hours**

PLANNING PROJECTS: Introduction, developing the project management plan, understanding stake holders, communication planning, project meeting management, communication needs of global and virtual project teams, communication technologies, Constructing Work Breakdown Structures – scope planning, scope definition, work breakdown structures (WBS), Using Microsoft project for work breakdown structures.

UNIT -3**13 Hours.**

SCHEDULING PROJECTS: purpose of a project schedule, historical development, how project schedules are limited and created, develop project schedules, uncertainty in project schedules, Gantt Chart, Using Microsoft Project for critical path schedules.

RESOURCING PROJECTS: Abilities needed when resourcing projects, estimate resource needs, creating staffing management plan, project team composition issues, assign resource to each activity, resource overloads, critical chain project management (CCPM), compress the project schedule, Using Microsoft Project for resource allocation.

Budgeting Projects: Cost planning, cost estimating, cost budgeting, establishing cost control, using Microsoft Project for Project Budgets,

UNIT -4**13 Hours.**

PROJECT RISK PLANNING: Risk Management Planning, risk identification, risk analysis, risk response planning, Project Quality Planning and Project Kickoff: Development of quality concepts, project quality management plan, project quality tools, kickoff project, baseline and communicate project management plan, using Microsoft Project for project baselines.

PERFORMING PROJECTS: Project supply chain management: - Plan purchasing and acquisitions, plan contracting, contact types, project partnering and collaborations, project supply chain management, Leading and Managing Project Teams – Acquiring, developing, managing and leading the project team, managing stakeholders, managing project conflicts.

UNIT -5

11 Hours

Determining Project Progress and Results: Project Balanced Scorecard Approach, Internal project, customer, financial issues, Using Microsoft Project to monitor and control projects. Finishing the project: Terminate project early, finish projects on time, secure customer feedback and approval, knowledge management, perform administrative and contract closure, celebrate success and reward participant, provide ongoing support.

ESSENTIAL READING:

1. Project Management, Timothy J Kloppenborg, Cengage Learning, Edition 2009.
2. Project Management, A systems approach to planning scheduling and controlling by Harold Kerzner, CBS publication.

RECOMMENDED READING:

1. Project Management Refer, Pennington Lawrence, Mc Graw Hill
2. Project Management, A Modern Joseph and Phillips New York Van Nostrand, Reinhold.
3. Project Management, Bhavesh M. Patal, Vikas publishing House

ME635 STATISTICAL QUALITY CONTROL**OBJECTIVES:**

- *Discuss the role of quality control in production and service operations*
- *Define and understand the terms chance cause, assignable cause, in control, out of control, attribute, and variable*
- *Construct and interpret a Pareto chart*
- *Construct and interpret a fishbone diagram*
- *Construct and interpret a mean and range chart*
- *Construct and interpret a percent defective and a c-bar chart*
- *Discuss acceptance sampling.*
- *Construct an operating characteristic curve for various sampling plans.*

OUTCOME:

- *To describe the fundamentals of statistics (Mean, Median, Mode).*
- *To explain the control charts for variables.*
- *To solve the process capability.*
- *To explain the control charts for attributes.*
- *To explain the Lot by lot acceptance sampling.*

UNIT – 1**13 Hours.**

INTRODUCTION: The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management (quality philosophy, links between quality and productivity, quality costs, legal aspects of quality implementing, quality improvement).

MODELING PROCESS QUALITY: Mean, Median, Mode, Standard deviation, Calculating area, The Deming funnel experiment, Normal distribution tables, Finding the Z score, Central limit theorem.

UNIT – 2**13 Hours.**

METHODS AND PHILOSOPHY OF STATISTICAL PROCESS CONTROL: Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length-ARL)

CONTROL CHARTS FOR VARIABLES: Control Charts for X-Bar and R- Charts, Type I and Type II errors, the probability of Type II error. Simple Numerical Problems

UNIT – 3**11 Hours**

PROCESS CAPABILITY: The foundation of process capability, Natural Tolerance limits, c_p – process capability index, c_{pk} , p_p – process performance index, summary of process measures. Numerical problems

UNIT 4:**11 Hours**

Control Charts For Attributes: Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, Control Charts for Nonconformities or Defects, Control Chart for Number of non conformities per unit. Numerical problems

UNIT – 5**12 Hours.**

LOT-BY-LOT ACCEPTANCE SAMPLING FOR ATTRIBUTES: The acceptance sampling problem, single sampling plan for attributes, Double, Multiple, and Sequential sampling, AOQL, LTPD, OC curves, Military Standard 105E, the Dodge-Romig sampling plans. Numerical problems

ESSENTIAL READINGS:

1. Statistical Quality Control, E.L. Grant and R.S. Leavenworth, 7th edition, McGraw- Hill publisher.
2. Statistical Quality Control, RC Gupta, Khanna Publishers, New Delhi, 2005

RECOMMENDED READING:

1. Statistical Process Control and Quality Improvement, Gerald M. Smith, Pearson Prentice Hall. ISBN 0 – 13-049036-9.
2. Statistical Quality Control for Manufacturing Managers, W S Messina, Wiley & Sons, Inc. New York, 1987
3. Statistical Quality Control, Montgomery, Douglas, 5th Edition, John Wiley & Sons, Inc. 2005, Hoboken, NJ (ISBN 0-471-65631-3).
4. Principles of Quality Control, Jerry Banks, Wiley & Sons, Inc. New York.

ELECTIVE-II (ME735)**ME735 MECHANISM DESIGN****OUTCOME:**

- *Explain the fundamentals of the theory of kinematics and dynamics of machinery.*
- *Describe the techniques for studying and designing the motion of machines and its components.*
- *Able to adopt computer software packages in modern machine design.*

UNIT-1**13 Hours.**

Planar Mechanisms and Geometry of Motion: Definitions and basic concepts, Classification of links, Classification of pairs, Mechanism and machine, Inversions, Grashof's law, Transmission of torque and force in mechanisms, Mobility, Degree of freedom permitted by joints other than turning and sliding, Equivalent mechanisms, Unique mechanisms.

Number Synthesis: Effect of even or odd number of links on degree of freedom, Minimum number of binary links in a mechanism, Minimum possible number of turning pairs, Enumeration of kinematic chain, Degree of freedom of special mechanisms.

UNIT-2**11 Hours.**

Synthesis of Linkages: Type, Number and dimensional synthesis, Function generation, Path generation and body guidance, Precision positions, Structural error, Chebychev spacing, Two position synthesis of slider crank mechanisms, Crank-rocker mechanisms with optimum transmission angle.

UNIT-3**12 Hours**

Motion Generation: Poles and relative poles, Relative poles of 4-bar mechanism, Relative poles of slider crank mechanism.

Graphical Methods of Dimensional Synthesis: Two position synthesis of crank and rocker mechanisms, Three position synthesis, Four position synthesis (point position reduction), Overlay method.

UNIT-4**11 Hours.**

Coupler Curves: Equation of coupler curves, Synthesis for path generation, Graphical synthesis for path generation, Robert-Chebyshev theorem (cognate linkages), Coupler curves from 5-bar mechanisms, Examples.

UNIT-5**13 Hours.**

Analytical Methods of Dimensional Synthesis: Freudenstein's equation for 4-bar mechanism and slider crank mechanism, Examples, Bloch's method of synthesis.

Cams: Introduction, Pressure angle, Parameters affecting pressure angle, Effect of offset follower motion, Radius of curvature and undercutting, Cams with specified contours.

ESSENTIAL READING:

1. "Theory of Machines & Mechanisms", J.J. Uicker, , G.R. Pennock, J.E. Shigley. OXFORD 3rd Ed.
2. 'Mechanism & Machine Theory', A.G. Ambekar, PHI, 2007

RECOMMENDED READING:

1. 'Kinematics, Dynamics & Design of Machinery', K. J. Waldron, G. L. Kinzel, Wiley India, 2007.
2. 'Advanced Mechanism Design', Erdman sandoor, Vol-I PHI, 2006,
3. "Kinematics & Dynamics of Machinery" H.H. Mabie, F.W. Ocvirk, John Wiley & Sons, New York, 3rd Ed.

ME735 THEORY OF PLASTICITY**OBJECTIVE:**

- *This chapter provides a basic theory of plasticity for the understanding of the flow curve.*
- *Differences between the true stress – true strain curve and the engineering stress – engineering strain curves will be highlighted.*
- *Finally the understanding of the yielding criteria for ductile materials will be made.*

OUTCOME

- *Solve two and three dimensional problems of cylindrical bodies.*
- *Know the stress strain relation for a body subjected to loading within elastic limit.*
- *Get the relation for a body subjected to thermal expansion.*

UNIT – 1**13 Hours**

FUNDAMENTAL OF ELASTICITY: Concept of stress, stress transformation laws, spherical and deviator stress tensors, equilibrium equations, octahedral stresses, concept of strain, deviator and spherical strain tensors, strain transformation laws, octahedral strains, generalized Hooke's law, elastic strain energy, compatibility equations, theories of strength. problems.

PLASTIC DEFORMATION OF METALS: Crystalline structure in metals, mechanism of plastic deformation, factors affecting plastic deformation, strain hardening, recovery, recrystallization and grain growth, flow figures or Luder's cubes.

UNIT – 2**11 Hours.**

CUBICAL DILATION, TRUE STRESS AND STRAIN: Strain tensor, principal strain, plane strain, spherical and deviator strain, octahedral strain and representative strain, problems.

UNIT – 3**13 Hours.**

STRESS STRAIN RELATIONS: Introduction, types of materials, empirical equations, theories of plastic flow, experimental verification of St. Venant's theory of plastic flow, the

concept of plastic potential, the maximum work hypothesis, mechanical work for deforming a plastic substance.

YIELD CRITERIA: Introduction, yield or plasticity conditions, Von Mises and Tresca criteria, Geometrical representation, yield surface, yield locus (two dimensional stress space), experimental evidence for yield criteria, energy required to change the shape with basic principle problems

UNIT – 4

10 Hours.

SLIP LINE FIELD THEORY: Introduction, basic equations for incompressible two dimensional flow, continuity equations, stresses in conditions of plain strain, convention for slip lines, solutions of plastic deformation problem, Geometry of slip line field, Properties of the slip lines, construction of slip line nets

UNIT – 5

13 Hours.

BENDING OF BEAMS: Analysis for stresses, Non linear stress strain curve, shear stress distribution, residual stresses in plastic bending, problems.

TORSION OF BARS: Introduction, plastic torsion of a circular bar, elastic perfectly plastic material, elastic work hardening of material, residual stresses and problems

ESSENTIAL READING:

1. 'Theory of Plasticity', Chakraborty 3rd Edition Elsevier.
2. 'Engineering Plasticity', W. Johnson and P. B. Mellor D Van N.O Strand Co. Ltd 2000

RECOMMENDED READING:

1. Basic Engineering Plasticity, DWA Rees 1st Edition Elsevier.
2. Theory of Plasticity, L. S. Srinath TMH,
3. Theory of Plasticity, Sadhu Singh, Kanna publisher

ME735 ENGINEERING DESIGN**OBJECTIVES:**

- *The student shall gain appreciation and understanding of the design function in mechanical engineering, the steps involved in designing and the relation of design activity with manufacturing activity.*
- *Shall be able to choose proper materials to different machine elements depending on their physical and mechanical properties. Thus he shall be able to apply the knowledge of material science in real life usage.*
- *Student shall gain a thorough understanding of the different types of failure modes and criteria. He will be conversant with various failure theories and be able to judge which criterion is to be applied in which situation.*
- *Student shall gain design knowledge of the different*
- *t types of elements used in the machine design process. Eg., fasteners, shafts, couplings etc. and will be able to design these elements for each application*

LEARNING OUTCOME:

- *To describe the various design process.*
- *To explain the various problem solving strategies.*
- *To explain the embodiment design and detail design.*
- *To explain the parameters of failures.*
- *To explain the parameter design and tolerance design.*
- *Will acquire skill to do select proper material for specific application.*
- *Will be in a position to do design for industrial application.*
- *Will be able to do design of mechanical elements.*
- *Will have sufficient ability to optimize.*

Enhances the capabilities to assume suitable technical specifications

UNIT 1:**11 Hours.**

Design Process: Introduction, History of Design Process, Design by innovation, inadequacies of traditional design methods, product Design process, product cost, quality and time to market

Detailed description of Design process:

Conceptual design, embodiment design, detail design, planning for manufacture, planning for distribution, planning for use planning for retirement, marketing, organization for design, designing to codes and standards, design renew product and process cycles, environmentally responsible design.

UNIT 2:**13 hours.**

Need Identification and Problem Definition: Introduction, identifying customer needs, gathering information from customers needs, generation of specifications.

Concept Generation and Evaluation: Introduction, creativity, problem solving, creativity methods, conceptual decomposition, Concept Generation Methods: Brain storming, 6-3-5 method, use of analogies, use of extremes and inverses, Morphological methods. Theory of inventive problem solving (TRIZ)

Concept Evaluation Methods: Based on feasibility judgment, assessment of technology readiness based on go-no-go screening, Pugh's method

UNIT 3**12 hours.**

Embodiment Design & Detail Design : Introduction product architecture, brief introduction to Configuration Design and parametric design.

Detail Design: Importance of Drawings, Drawings produced during Design process. Bill of materials: Brief introduction to modeling and simulations, prototypes and testing, rapid prototyping .Final Design Review.

Materials Selection and Materials in Design :Introduction, general criteria for material selection, performance characteristics of materials, material selection process, illustration of Ashby charts, methods of material selection, material performance indices, decision matrices, Pugh's selection method, Weighted property index method, Value analysis.

UNIT 4

Design For X (DFX): General introduction, Design for Manufacture (DFM): Introduction, DFM guidelines, Specific Design Rules. Design for Assembly (DFA): Introduction, DFA guidelines. Design for Reliability (DFR): Introduction, Bath-tub curve, Mean life, MTTF and MTBF,

Failure rate(Constant and Variable), Exponential and Weibull reliability functions, System reliability concepts-Series and Parallel systems.

Design for Environment (DFE): Introduction, DFE practices, Introduction to Design for Test and Maintenance(Serviceability),Introduction to Industrial Design.

UNIT 5:**12 Hours.****Cost Considerations and Human Factors in Engineering Design:****Robust and Quality Design:** Introduction, concept of total quality control and assurance, Taguchi's quality loss functions, Robust design: Parameter design and tolerance design.**ESSENTIAL READINGS**

1. Engineering Design: A Materials and Processing Approach: George E. Dieter, Mc Graw Hill, 1991.
2. The Mechanical Design Process, David G. Ullman, Mc Graw Hill, 2003

RECOMMENDED READING

1. Product Design & Development: Karl T. Ulrich & Steven D, Epingner, Tata Mc Graw Hill, 3rd Edition, 2003
2. Engineering Design Principles: Ken Hurst, Elsevier, 2010
3. An introduction to Engineering Design Method: V Gupta and P Murthy, Tata Mc Graw Hill, 2000
4. Introduction of Engineering Design: T. Woodson, McGraw Hill, 2001
5. Design & Planning of Engineering systems: D. D. Meredith, K.W. Wong, R.W.Woodhead & K. K.Worthman,2000
6. Introduction to Design: M.A. Asimov, Prentice Hall, 1996
7. Product Design and Manufacturing: A.C. Chitale and R.C. Gupta, PHI 4TH edition 2007

ME735 GAS DYNAMICS**OBJECTIVES:**

- To familiarize with behavior of compressible gas flow
- To understand the difference between subsonic and supersonic flow
- To familiarize with high speed test facilities

OUTCOME:

Ability to

- To distinguish between various flow regimes
- To analyse the flow under different flow conditions

To assess the flow behavior and consequent loads due to flow

UNIT – 1**11 Hours**

FUNDAMENTAL EQUATIONS OF STEADY FLOW: Continuity and momentum equations, The thrust function, The dynamic equation and Euler's Equation. Bernoulli's Equation. Steady flow energy equation.

UNIT-2**12 Hours.**

ISENTROPIC FLOW: Acoustic velocity, Mach number, Mach cone and Mach angle. Flow parameters, stagnation temperature, pressure, and density.

ADIABATIC FLOW: Stagnation temperature change. Rayleigh line, Pressure ratio and temperature ratio, Entropy considerations, maximum heat transfer.

UNIT – 3**12 Hours**

FLOW WITH FRICTION: The fanning equation, Friction factor and friction parameter, Fanno line, Fanno equations.

WAVE PHENOMENA: Classification of wave phenomena, analysis of shock phenomena, Hugoniot equation. Weak waves, compression waves, Normal shock waves, oblique shock waves, Entropy considerations, Rayleigh Pilot equations, detonation and deflagration.

UNIT – 4**11 Hours.**

VARIABLE AREA FLOW: Velocity variation with Isentropic flow, Criteria for acceleration and deceleration. Effect of pressure ratio on Nozzle operation. Convergent nozzle and convergent divergent nozzle. Effect of back pressure on nozzle flow. Isothermal flow functions. Comparison of flow in nozzle. Generalized one dimensional flow.

UNIT – 5**13 Hours.**

Applications of dimensional analysis and similitude to gas dynamic problems.

INTRODUCTION TO FLAMES AND COMBUSTION: Flame propagation, diffusion flames, premixed flames, flame velocity, theories of flame propagation, ignition for combustible mixture, flame stabilization.

ESSENTIAL READINGS:

1. Fundamentals of Compressible flow: Yahya, 2nd Edn. 1991; Wiley Eastern.
2. Gas Dynamics, E Radhakrishnan PHI-2006

RECOMMENDED READING:

1. Introduction to Gas Dynamics: Roly, wiley 1998
2. Elements of Gas Dynamics: Liepmann and roshko, Wiley 1994.
3. The dynamics and thermodynamics of compressible fluid flow: Shapiro Ronold press. 1994.
4. Compressible Fluid Flow, J. F. Anderson

ME735 AUTOMATION IN MANUFACTURING**OBJECTIVES:**

- Define what is meant by a manufacturing system
- Specify the general material handling processes that may be distinguished
- List the types of work transport to be encountered, and the equipment used to carry it out
- Explain what computer functions are utilised in automated manufacturing
- Describe why the number of workstations has an impact upon the type of manufacturing system implemented.
- Explain why workstation layout is an important consideration in the manufacturing system
- Define what is meant by the manning level of a workstation, and list the levels themselves for single and multi-station systems
- Specify the importance of part or product variety for manufacturing systems
- Describe single- and multi-station systems
- List the enablers for unattended cell operation
- Calculate the length of time that the automated cell can theoretically operate unattended
- Determine the number of workstations that are required in a system
- Define a machine cluster

LEARNING OUTCOME:

Upon completion of the subject, students will be able to

- *Explain automation in Production systems, Automation principles & Strategies.*
- *Understand the different Manufacturing Operations.*
- *Identify the different types of industrial control system and automated manufacturing systems.*
- *describe the concept of group technology & flexible manufacturing systems.*
- *Classify the different method of quality control systems and inspection technologies.*
- *explain the different manufacturing support systems in the industries.*

UNIT – 1**12 Hours.**

INTRODUCTION: Production System Facilities, Manufacturing Support systems, Automation in Production systems, Automation principles & Strategies

MANUFACTURING OPERATIONS: Manufacturing Operations, Product/Production Relationship, Production concepts and Mathematical Models & Costs of Manufacturing Operations

UNIT – 2

13 Hours.

INDUSTRIAL CONTROL SYSTEM: Basic Elements of an Automated System, Advanced Automation Functions & Levels of Automation, Continuous versus Discrete control, Computer Process control, Forms of Computer Process Control.

AUTOMATED MANUFACTURING SYSTEMS: Components of a Manufacturing systems, Classification of Manufacturing Systems, overview of Classification Scheme, Single Station Manned Workstations and Single Station Automated Cells.

UNIT – 3

11 Hours.

GROUP TECHNOLOGY & FLEXIBLE MANUFACTURING SYSTEMS: Part Families, Parts Classification and coding, Production Flow Analysis, Cellular Manufacturing, Flexible Manufacturing Systems: What is an FMS, FMS Components, FMS Applications & Benefits, and FMS Planning & Implementation Issues.

UNIT -4

12 Hours.

QUALITY CONTROL SYSTEMS: Traditional and Modern Quality Control Methods, Taguchi Methods in Quality Engineering. Introduction to SQC Tools.

INSPECTION TECHNOLOGIES: Automated Inspection, Coordinate Measuring Machines Construction, operation & Programming, Software, Application & Benefits, Flexible Inspection System, Inspection Probes on Machine Tools, Machine Vision, Optical Inspection Techniques & Noncontact Nonoptical Inspection Technologie

UNIT – 5

11 Hours.

MANUFACTURING SUPPORT SYSTEM: Process Planning, Computer Aided Process Planning, Concurrent Engineering & Design for Manufacturing, Advanced Manufacturing

Planning, Just-in Time Production System, Basic concepts of lean and Agile manufacturing.
Basic Concepts of Lean and Agile manufacturing, Comparisons of Lean & Agile Manufacturing.

ESSENTIAL READINGS:

1. Automation, Production Systems and Computer Integrated Manufacturing, M. P. Groover, Pearson education. Third Edition, 2008
2. Principles of CIM, Vajpayee, PHI.

RECOMMENDED READING:

1. Anatomy of Automation, Amber G.H & P. S. Amber, Prentice Hall.
2. Performance Modeling of Automated Manufacturing Systems, Viswanandham, PHI
3. Computer Based Industrial Control, Krishna Kant, EEE-PHI

ME735 TOTAL QUALITY MANEGEMENT**OBJECTIVE:**

- *Process improvement*
- *Defect prevention*
- *Priority of effort*
- *Developing cause-effect relationships*
- *Measuring system capacity*
- *Developing improvement checklist and check forms*
- *Helping teams make better decisions*
- *Developing operational definitions*
- *Separating trivial from significant needs*
- *Observing behaviour changes over a period of time*

LEARNING OUTCOME

- *Student will be Able to apply quality philosophy in his work.*
- *Able to apply TQM philosophy for the benefit of the organization by imparting training.*
- *Able to apply the philosophy to minimize defects and retain customer satisfaction at all levels.*
- *Able to analyse and pinpoint defects generated from various production units and control them.*

UNIT – 1**12 Hours.**

Principles and Practice: Definition, basic approach, gurus of TQM, TQM Framework, awareness, defining quality, historical review, obstacles, benefits of TQM.

Leadership: Definition, characteristics of quality leaders, leadership concept, characteristics of effective people, ethics, the Deming philosophy, role of TQM leaders, implementation, core values, concepts and framework, strategic planning communication, decision making,

UNIT – 2**12 Hours.**

Customer Satisfaction and Customer Involvement: Customer Satisfaction : customer and customer perception of quality, feedback, using customer complaints, service quality, translating needs into requirements, customer retention, Case studies.

Employee Involvement – Motivation, employee surveys, empowerment, teams, suggestion system, recognition and reward, gainsharing, performance appraisal, unions and employee involvement, case studies.

UNIT – 3**12 hours.**

Continuous Process Improvement: process, the Juran trilogy, improvement strategies, types of problems, the PDSA Cycle, problem-solving methods, Kaizen, reengineering, six sigma, case studies.

Tools and Techniques: Benching marking, information technology, quality management systems, environmental management system, quality function deployment, quality by design, failure mode and effect analysis, product liability, total productive maintenance.

UNIT – 4**12 Hours.**

Quality Management Tools : Why Why, forced field analysis, nominal group technique, affinity diagram, interrelationship digraph, tree diagram, matrix diagram, prioritization matrices, process decision program chart, activity network diagram.

Statistical Process Control : Pareto diagram, process flow diagram, cause-and-effect diagram, check sheets, histograms, statistical fundamentals, Control charts, state of control, out of control process, control charts for variables, control charts for attributes, scatter diagrams, case studies.

UNIT – 5**12 hours.**

Building and Sustaining Performance Excellence in Organizations : Making the commitment to total quality, organizational culture and total quality, change management, sustaining the quality organization, self-assessment processes, implementing ISO 9000, Baldrige, and six sigma, a view toward the futures

Design for Six Sigma: Tools for concept development, tools for design development, tools for design optimization, tools for design verification, problems.

ESSENTIAL READINGS:

1. Total Quality Management: Dale H. Bester field, Publisher - Pearson Education India, ISBN: 8129702606, Edition 03/e Paperback (Special Indian Edition)
2. Total Quality Management for Engineers: M. Zairi, ISBN: 1855730243, Publisher: Wood head Publishing

RECOMMENDED READING:

1. A New American TQM, four revolutions in management, Shoji Shiba, Alan Graham, David Walden, Productivity press, Oregon, 1990
2. 100 Methods for Total Quality Management: Gopal K. Kanji and Mike Asher, ISBN: 0803977476, Publisher: Sage Publications, Inc.; Edition – 1
3. Organisational Excellence through TQM, H. Lal, New age pub, 2008

ELECTIVE –III (ME736)**ME736 EXPERIMENTAL STRESS ANALYSIS****OBJECTIVES**

- *To understand the relation between the mechanics theory and experimental stress analysis.*
- *To establish the fundamental concepts and newly experimental techniques.*
- *To be able to use the experimental techniques on the practical problems.*
- *To be able to make a fine presentation related to the experimental paper.*

LEARNING OUTCOME

- *To describe the Sensitivity & the construction of strain gauges.*
- *To elucidate the isoclinics & Fringe multiplication techniques.*
- *To explain the stress separation methods of 3D photoelasticity.*
- *To describe the Birefringence coating techniques.*
- *To describe the Moire's Techniques.*

UNIT-1**13 Hours.**

Electrical Resistance Strain Gages: Strain sensitivity in metallic alloys, Gage construction, Adhesives and mounting techniques, Gage sensitivity and gage factor, Performance Characteristics, Environmental effects, Strain Gage circuits. Potentiometer, Wheatstone's bridges, Constant current circuits.

Strain Analysis Methods: Two element, three element rectangular and delta rosettes, Correction for transverse strain effects, Stress gage, Plane shear gage, Stress intensity factor gage.

UNIT-2**11 Hours.**

Photoelasticity: Nature of light, Wave theory of light - optical interference, Stress optic law – effect of stressed model in plane and circular polariscope, Isoclinics & Isochromatics, Fringe order determination Fringe multiplication techniques, Calibration photoelastic model materials

UNIT-3**12 hours.**

Two Dimensional Photoelasticity: Separation methods: Shear difference method, Analytical separation methods, Model to prototype scaling, Properties of 2D photoelastic model materials, Materials for 2D photoelasticity

Three Dimensional Photo elasticity: Stress freezing method, Scattered light photoelasticity, Scattered light as an interior analyzer and polarizer, Scattered light polariscope and stress data Analyses.

UNIT-4**13 Hours.**

Photoelastic (Birefringent) Coatings : Birefringence coating stresses, Effects of coating thickness: Reinforcing effects, Poission's, Stress separation techniques: Oblique incidence, Strip coatings **Brittle**

Coatings: Coatings stresses, Crack patterns, Refrigeration techniques, Load relaxation techniques, Crack detection methods, Types of brittle coatings, Calibration of coating. Advantages and brittle coating applications.

UNIT-5**11 Hours.**

Moire Methods: Moire fringes produced by mechanical interference .Geometrical approach, Displacement field approach to Moire fringe analysis ,Out of plane displacement measurements, Out of plane slope measurements .Applications and advantages

ESSENTIAL READINGS:

1. "Experimental Stress Analysis", Dally and Riley, McGraw Hill.
2. "Experimental Stress Analysis". Sadhu Singh, Khanna publisher.
3. Experimental stress Analysis, Srinath L.S tata Mc Graw Hill.

REFERENCES BOOKS :

1. "Photoelasticity Vol I and Vol II, M.M.Frocht, John Wiley & sons.
2. "Strain Gauge Primer", Perry and Lissner,
3. "Photo Elastic Stress Analysis", Kuske, Albrecht & Robertson John Wiley & Sons.
4. "Motion Measurement and Stress Analysis", Dave and Adams,

ME736 CRYOGENICS**OBJECTIVES**

The goal of this program is to provide:

- *A fundamental and theoretical foundation of knowledge pertaining to Cryogenic*
- *A concrete grasp of the applications of Cryogenics Engineering as it is used in the aerospace industry.*

UNIT- 1**11 Hours.****INTRODUCTION TO CRYOGENIC SYSTEMS:**

Applications Areas of Cryogenic Engineering

Low temperature properties of engineering materials – Mechanical properties, Thermal properties, Electrical properties.

Introduction The Thermodynamically Ideal system Production of low temperatures – Joule Thompson Effect, Adiabatic expansion.

UNIT- 2**13 Hours.**

GAS LIQUIFICATION SYSTEMS: Liquification systems for Air Simple Linde – Hampson System, Claude System, Heylndt System, Dual pressure, Claude.

Liquefaction cycle Kapitza System. Comparison of Liquefaction Cycles Liquefaction cycle for hydrogen, helium and Neon, Critical components of liquefaction systems.

GAS CYCLE CRYOGENIC REFRIGERATION SYSTEMS: Classification of Cryo coolers Stirling cycle Cryo – refrigerators, Ideal cycle – working principle. Schmidt’s analysis of Stirling cycle Various configurations of Stirling cycle refrigerators Integral piston Stirling cryo-cooler, Free displacer split type Stirling Cryo coolers, Gifford McMahon Cryo- refrigerator, Pulse tube refrigerator, Solvay cycle refrigerator, Vuillimier refrigerator, Cryogenic regenerators.

UNIT- 3**13 Hours.**

GAS SEPARATION AND GAS PURIFICATION SYSTEMS: Thermodynamic ideal separation system, Properties of mixtures, Principles of gas separation, Linde single column air separation. Linde double column air separation, Argon and Neon separation systems. Adsorption Process, PSA systems.

ULTRA LOW TEMPERATURE CRYO – REFRIGERATORS:

Magneto Caloric Refrigerator ^3He - ^4He Dilution refrigerator. Pomeranchuk cooling.

Measurement systems for low temperatures, Temperature measurement at low temperatures, Resistance thermometers, Thermocouples, Thermistors, Gas Thermometry. Liquid level sensors.

UNIT – 4**11 Hours.**

VACUUM TECHNOLOGY: Fundamental principles. Production of high vacuum, Mechanical vacuum pumps, Diffusion pumps, Cryo-pumping, Measurement of high vacuum level.

Cryogenic Insulation: Heat transfer due to conduction, Evacuated porous insulation Powder & Fibers Opacified powder insulation, Gas filled powders & Fibrous materials Multilayer super-insulation, Composite insulation.

UNIT-5**13 Hours**

CRYOGENIC FLUID STORAGE AND TRANSFER SYSTEMS: Design of cryogenic fluid storage vessels, Inner vessel, Outer Insulation, Suspension system, Fill and drain lines. Cryogenic fluid transfer, External pressurization, Self pressurization, Transfer pump.

APPLICATION OF CRYOGENIC SYSTEMS: Cryogenic application for food preservation – Instant Quick Freezing techniques 11.2 Super conductive devices, Cryogenic applications for space technology.

ESSENTIAL READINGS:

1. Cryogenic Systems, Randall Barron – Oxford Press, 1985
2. Cryogenic Engineering, Thomas M. Flynn, Marcel Dekker, Inc N.Y. Basal 1997

REFERENCE BOOK:

1. Cryogenic Process Engineering, Klaus D. Timmerhaus & Thomas M. Flynn, Plenum Press, New York & London 1989.

ME736 SMART MATERIALS**OBJECTIVES**

- Identify the strengths of a given class of materials regarding their use as smart materials.
- Identify the weaknesses of a given class of materials regarding their use as smart materials.
- Select a candidate smart material for a given orthodontic application.
- Factor the strengths and weaknesses of a smart material into the design of a product in orthodontic application

LEARNING OUTCOMES:

- To explain the overview of Smart materials.
- To describe the attributes of Smart Materials.
- To explain the operation of Smart Sensors.
- To elucidate the signal conditioning techniques.

UNIT – 1**11 Hours.**

INTRODUCTION: Characteristics of composites and ceramics materials, Dynamics and controls, concepts, Electro-magnetic materials and shape memory alloys-processing and characteristics

UNIT-2**11 Hours**

SENSING AND ACTUATION: Principals of electromagnetic, acoustics, chemical and mechanical sensing and actuation, Types of sensors and their applications, their compatibility writer conventional and advanced materials, signal processing, principals and characterization.

UNIT -3**13 Hours.**

CONTROL DESIGN: Design of shape memory alloys, Types of MR fluids, Characteristics and application, principals of MR fluid valve designs, Magnetic circuit design, MR Dampers, Design issues.

OPTICS AND ELECTROMAGNETIC: Principals of optical fiber technology, characteristics of active and adaptive optical system and components, design and manufacturing principles.

UNIT-4**12 Hours.**

STRUCTURES: Principles of drag and turbulence control through smart skins, applications in environment such as aerospace and transportation vehicles, manufacturing, repair and maintainability aspects.

Controls: Principles of structural acoustic control, distributed, analog and digital feed back controls, Dimensional implications for structural control.

UNIT - 5

PRINCIPLES OF VIBRATION AND MODAL ANALYSIS: PZT Actuators, MEMS, Magnetic shape Memory Alloys, Characteristics and Applications.

INFORMATION PROCESSING: Neural Network, Data Processing, Data Visualisation and Reliability – Principals and Application domains.

TEST BOOKS:

1. Analysis and Design', A. V. Srinivasan, 'Smart Structures –Cambridge University Press, New York, 2001, (ISBN : 0521650267)
2. 'Smart Materials and Structures', M V Gandhi and B S Thompson Chapman & Hall, London, 1992 (ISBN : 0412370107)

RECOMMENDED READING:

1. 'Smart Materials and Structures', Banks HT, RC Smith, Y Wang, Massow S A, Paris 1996
2. G P Gibbs' Adaptive Structures', Clark R L, W R Saulniers, Jhon Wiles and Sons, New York, 1998
3. An introduction for scientists and Engineers', Esic Udd, Optic Sensors : Jhon Wiley & Sons, New York, 1991 (ISBN : 0471830070)

ME736 AGILE MANUFACTURING**UNIT – 1****13 Hours.**

AGILE MANUFACTURING: Definition, business need, conceptual frame work, characteristics, generic features.

DEVELOPING AGILE MANUFACTURING: Enterprise, Strategies, integration of organization, workforce and technology, reference models, examples.

UNIT – 2**13 Hours.**

INTEGRATION OF PRODUCT /PROCESS DEVELOPMENT: Principles, Robust design approach, Approaches to enhance ability in manufacturing, Role of QFD, Managing people in Agile organisation, Approaches.

UNIT – 3**12 Hours.**

APPLICATION OF IT/IS CONCEPTS IN AGILE MANUFACTURING: Strategies, Management of complexities and information. flow, approaches, applications of multimedia to improve agility in manufacturing, system concepts.

AGILE SUPPLY CHAIN MANAGEMENT: Principles, IT/IS concepts in supply chain management, enterprise integration and management in agile manufacturing, concepts, Agility, Adaptability and learners – comparison of concepts.

UNIT – 4**11 Hours.**

COMPUTER CONTROL OF AGILE MANUFACTURING: CAPP for Agile Manufacturing, Aggregate capacity planning and production line design / redesign in Agile manufacturing, Cellular manufacturing, concepts, examples.

UNIT – 5**11 Hours.**

CORPORATE KNOWLEDGE MANAGEMENT IN AGILE MANUFACTURING: Strategies, strategic options in Agile manufacturing, Role of standards.

DESIGN OF SKILL & KNOWLEDGE: Enhancing technology for Machine tool system, Resumption of design requirement geometry, definition, methods, decision support for selection of cutting parameters, design enhancements, parametric approach only.

ESSENTIAL READINGS:

1. ‘Agile Manufacturing- Forging Mew Frontiers’, Poul T Kidd, Amagow Co. UK, ISBN-0-201-63163-6, 1994
2. “Agile Manufacturing”, A Gunasekharan, the 21st Century Competitive strategy, ISBN - 13 978-0-08-04 3567-1, Elsevier Press, India

RECOMMENDED READING:

1. O Levine Transitions to Agile Manufacturing, Joseph C Moutigomery and Lawrurence – Staying Flexible for competitive advantage, ASQC quality press, Milwaukee. Wisconsin, USA 1996
2. Agile Development for Mass Customization, David M Andeson and B Joseph Pine, Irwin Professional Publishing, Chicogo USa 1997

ME736 FINANCIAL MANAGEMENT**OBJECTIVES:**

This course is designed as a survey course for students in a graduate management program. We will begin with a general overview of financial statements and then go into more detail about financial concepts, financial instruments and techniques used in financial decision-making.

The main objectives of this course are to introduce you to the:

- world of finance. Anyone involved in the management of a business needs to have a basic knowledge of business finance and*
- basic financial concepts such as the time value of money, asset valuation, and risk and return.*

UNIT – 1**12 Hours.**

INTRODUCTION TO FINANCIAL MANAGEMENT: Forms of organization, direct and indirect taxes. Statutory Registration- excise Duty, central sales tax, VAT, service tax, international fund availability.

RISK AND REQUIRED RETURN: Risk and return relationship, methods of measuring the risk, Business risk, financial risk, calculation of expected rate of return to the portfolio, numerical problems.

UNIT – 2**12 Hours.**

WORKING CAPITAL MANAGEMENT: Definition, need and factors influencing the working capital requirement. Determination of operating cycle, cash cycle and operating cycle analysis. Calculation of gross working capital and net working capital requirement.

UNIT – 3**11 Hours.**

LONG TERM FINANCING: Raising of finance from primary and secondary markets. Valuation of securities, features of convertible securities and warrants. Features of debt, types of debt instruments, return on investment(ROI) and credit rating of units. Shares, debentures.

UNIT – 4**13 Hours.**

INTRODUCTION: Book keeping – systems of book keeping, journal and ledger posting. Financial Statement, Preparation of Trial balance, profit and Loss Account, Balance Sheet with adjustments.

RATIO ANALYSIS / ACCOUNTING RATIO: Liquidity ratio – Current ratio, quick ratio, turnover ratio, capital structure ratio- Debt – equity ratio, Coverage ratio, Profitability ratio, Profit margin, Return on assets, Activity ratios – Inventory turnover ratio, Debtors Turnover ratio. Preparation of the balance sheet from various ratios. Analysis of any one published balanced sheet.

UNIT – 5

12 Hours.

COSTING: Classification of cost, preparation of cost sheet, absorption and variable costing, job costing, process costing. Classification of the variances analysis – material, labour and overhead variances.

BUDGETING: Types of budgets – Flexible budgets, preparation of cash budgets, purchase and production budgets and master budget, Budgetary control, advantages & limitations of budgeting.

ESSENTIAL READINGS:

1. Financial Management, Khan & Jain, text & problems TMH ISBN 0-07-460208-A. 20001
2. Financial Accounting, Costing and Management Accounting, S. M. Maheshwari, 2000

RECOMMENDED READING:

1. Financial Management, I. M. Pandey, Vikas Publication House ISBN 0-7069-5435-1. 2002
2. Financial Management, Abrish Gupta, Pearson.
3. Financial Decision Making, Humpton. 2000
4. Financial Management, Theory and Practice, Prasanna Chandra TMH ISBN -07-462047-9, 3rd edition 2002

ME736 INTERNAL COMBUSTION ENGINES**OBJECTIVE:**

The aim of this technical report is:

- *Introducing different types of internal combustion engines, based on different categorization.*
- *Familiarization with the mechanism of operation of each, and the thermodynamic relations behind its theoretical cycles.*

LEARNING OUTCOMES

- By studying this course students will be able to
- Classify IC Engines and explain their working
- Explain different thermodynamic cycles on which engines work and derive expressions for mean effective pressure and efficiency
- Compare different engines
- Describe engine knocking and parameters effecting engine knocking
- Explain the working of engine cooling, carburetion, and injection system
- Application of dual fuel operation and modern technology in combustion, design and fuel systems
- Explain vehicular pollution and its control methods

UNIT – 1**7 Hours**

THERMODYNAMIC CYCLE ANALYSIS: Deviation from ideal processes. Effect of chemical equilibrium and variable specific heats. Effect of air fuel ratio and exhaust gas dilution. Calculation of combustion temperatures. Use of combustion charts. Simple. numerical problems.

COMBUSTION IN C.I. ENGINES: Ricardo's three stages of combustion process in C.I. engines. Delay period & factors affecting delay period. Diesel knock- Methods of controlling diesel knock. Knock rating of Diesel fuels.

UNIT -2**6 Hours**

COMBUSTION CHAMBERS: Requirements of combustion chambers. Features of different types of combustion chambers system for S.I. engine. I-head, F-head combustion chambers. C.I. engine combustion chambers-Air swirl turbulence-M. type combustion chamber. Comparison of various types of combustion chambers.

UNIT -3**6 Hours**

CARBURATION AND COMBUSTION PROCESS IN S.I. ENGINES: Mixture requirements in S.I engine. Simple Carburetor and its limitations. Knock fee and knocking combustion-Theories of combustion process in S.I. engines. Effect of Knock on engine performance. Effect of operating variables on knocking. Knock rating of fuels-octane number. HUCR values. Anti knock agents - Pre ignition - Post ignition.

UNIT – 4**8 Hours**

FUELS: Hydro carbons - chemical structure-influence of chemical structure on knock alternative fuels-Alcohols-vegetable oils- Bio gas as Diesel engine fuels.

5 Hours

FUEL INJECTION SYSTEMS: Diesel injection systems-jerk pump injectors Nozzles of different types-Petrol injection systems for S.I. engines-Electronic fuel injection system. Cooling system- Water cooling, air cooling & liquid cooling-role of thermostats-radiator construction.

UNIT - 5**7 Hours**

EMISSION REGULATION AND CONTROL SYSTEMS: Mechanism of pollutant formation. Total emission control package thermal reactor package-catalytic converter package-control of NO_x -Exhaust gas recirculation-Water injection.

MODERN DEVELOPMENTS: Turbo charging and super charging of I.C.engines, Stratified charge engines (Lean burned SIengine) Multi fuel engines, Rotary piston engine, Two injector engines Pilot ignition engine, all ceramic swirl chamber engines.

ESSENTIAL READING:

1. **A course in I.C. Engines**, M. L. Mathur and R. P. Sharma 20001.
2. **Internal Combustion Engines**, Colin R. Ferguson C. John Wiley & sons, 1986

RECOMMENDED READING:

1. **I.C. Engines**, Edward. F. Obert, Harper International edition, 1973.
2. **Internal Combustion Engines**, Ganeshan, Tata McGraw Hill, 2nd Edition, 2003.
3. **Engineering Fundamentals of the I.C. Engine**, Willard W. Pulkrabek. 1998.
4. **Combustion Engine Process**, Lichty, Judge 2000

ELECTIVE-IV (ME833)**ME833 TRIBOLOGY****OBJECTIVE:**

- Describe surface topography, physico-chemical aspects of solid surfaces, and surface interactions.
- Analyze the mechanics of solid elastic and elastoplastic contacts.
- Recognize the laws of friction, mechanisms of friction, friction space, stiction, stick slip, and surface temperature.
- Appreciate the various modes of wear: adhesive, delamination, fretting, abrasive, erosive, corrosive, oxidational (mild and severe), melt, and the wear-mechanism maps.
- Identify types of lubrication: boundary, solid-film, hydrodynamic, and hydrostatic lubrication.
- Examine applications/case studies: sliding contacts, rolling contacts, bearing design, coating selection, and lubrication.
- Explore the design of tribological surfaces and how to troubleshoot tribology problems.
- Survey tribological testing devices and testing design.

UNIT – 1**13 Hours.**

INTRODUCTION TO TRIBIOLOGY: Properties of oils and equation of flow: Viscosity, Newton's Law of viscosity, Hagen-Poiseuille Law, Flow between parallel stationary planes, viscosity measuring apparatus. Lubrication principles, classification of lubricants.

HYDRODYNAMIC LUBRICATION: Friction forces and power loss in lightly loaded bearing, Petroff's law, Tower's experiments, idealized full journal bearings.

UNIT – 2**11 Hours.**

MECHANISM OF PRESSURE DEVELOPMENT IN AN OIL FILM: Reynold's investigations, Reynold's equation in two dimensions. Partial journal bearings, end leakages in journal bearing, numerical problems.

UNIT – 3**11 Hours.**

SLIDER / PAD BEARING WITH A FIXED AND PIVOTED SHOE: Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a pivoted shoe bearing, influence of end leakage, numerical examples.

UNIT – 4**13 Hours.**

OIL FLOW AND THERMAL EQUILIBRIUM OF JOURNAL BEARING: Oil flow through bearings, self-contained journal bearings, bearings lubricated under pressure, thermal equilibrium of journal bearings.

HYDROSTATIC LUBRICATION: Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing.

UNIT – 5**11 Hours.**

BEARING MATERIALS: Commonly used bearings materials, properties of typical bearing materials. **Wear:** Classification of wear, wear of polymers, wear of ceramic materials, wear measurements, effect of speed, temperature and pressure.

BEHAVIOR OF TRIBOLOGICAL COMPONENTS: Selection, friction, Wear of ceramic materials, wear measurements, effects of speed, temperature and pressure. Tribological measures, Material selection, improved design, surface engineering.

ESSENTIAL READINGS:

1. Fundamentals of Tribology , Basu S K., Sengupta A N., Ahuja B. B., , PHI 2006
2. Introduction to Tribology Bearings, Mujumdar B. C., S. Chand company pvt. Ltd 2008.

REFERENC BOOKS:

1. Theory and Practice of Lubrication for Engineers, Fuller, D., New York company 1998
2. Principles and Applications of Tribology, Moore, Pergamaon press 1998
3. Tribology in Industries, Srivastava S., S Chand and Company limited, Delhi 2002
4. Lubrication of bearings – Theoretical Principles and Design, Redzimovskay E I., Oxford press company 2000

ME833 FRACTURE MECHANICS**OBJECTIVE:**

The course will treat linear and nonlinear fracture mechanics principles and their applications to structural design. Fracture phenomena in metals and nonmetals will be discussed and testing methods will be highlighted. In the end computer assisted techniques for fracture study will be discussed

LEARNING OUTCOME:

- *Predict material failure for any combination of applied stresses.*
- *Estimate failure conditions of a structure.*
- *Determine the stress intensity factor for simple components of simple geometry.*
- *Predict the likelihood of failure of a structure containing a defect.*

UNIT – 1**13 Hours.**

FRACTURE MECHANICS PRINCIPLES: Introduction, Mechanisms of Fracture, a crack in structure, the Griffith's criterion, modern design – strengths, stiffness and toughness. Stress intensity approach

STRESS ANALYSIS FOR MEMBERS WITH CRACKS: Linear elastic fracture mechanics, Crack tip stress and deformations, Relation between stress intensity factor and fracture toughness, Stress intensity based solutions. Crack tip plastic zone estimation, Plane stress and plane strain concepts. The Dugdale approach, the thickness effect.

UNIT – 2**12 Hours.**

ELASTIC – PLASTIC FRACTURE MECHANICS: Introduction, Elasto-plastic factor criteria, crack resistance curve, J-integral, Crack opening displacement, crack tip opening displacement. Importance of R-curve in fracture mechanics, experimental determination of J-integral, COD and CTOD.

UNIT -3**13 Hours.**

DYNAMIC AND CRACK ARREST: Introduction, the dynamic stress intensity and elastic energy release rate, crack branching, the principles of crack arrest, the dynamic fracture toughness.

FATIGUE AND FATIGUE CRACK GROWTH RATE: Fatigue loading, various stages of crack propagation, the load spectrum, approximation of the stress spectrum, the crack growth integration, fatigue crack growth laws.

UNIT – 4**11 Hours.**

FRACTURE RESISTANCE OF MATERIALS: Fracture criteria, fatigue cracking criteria, effect of alloying and second phase particles, effect of processing and anisotropy, effect of temperature, closure.

UNIT – 5**11 Hours.**

COMPUTATIONAL FRACTURE MECHANICS: Overview of numerical methods, traditional methods in computational fracture mechanics – stress and displacement marching, elemental crack advance, virtual crack extension, the energy domain integral, finite element implementation. Limitations of numerical fracture analysis.

FRACTURE TOUGHNESS TESTING OF METALS: Specimen size requirements, various test procedures, effects of temperature, loading rate and plate thickness on fracture toughness. Fracture testing in shear modes, fatigue testing, NDT methods.

ESSENTIAL READINGS:

1. Introduction to Fracture Mechanics, Karen Hellan McGraw Hill Pub.2000
2. Fracture of Engineering Brittle Materials, Jayatilake, Applied Science, London. 2001.

RECOMMENDED READING:

1. Fracture Mechanics – Fundamentals and Application, T.L. Anderson, CRC press 1998
2. Elementary Engineering Fracture Mechanics, David Broek, Artinus Nijhoff, London 1999.
3. Fracture and Fatigue Control in Structures, Rolfe and Barsom, Printice Hall 2000.
4. Fundamentals of Fracture Mechanics, Knott, Bureworth 2000.

ME833 POWER PLANT ENGINEERING**OBJECTIVE:**

- *Describe sources of energy and types of power plants*
- *Analyze different types of steam cycles and estimate efficiencies in a steam power plant*
- *Describe basic working principles of gas turbine and diesel engine power plants. Define the performance characteristics and components of such power plants*
- *List the principal components and types of nuclear reactors.*
- *Evaluate cycle efficiency and performance of a gas cooled reactor power plant Classify different types of coupled vapor cycles and list the advantages of combined cycles power plant*
- *List different types of fuels used in power plants and estimate their heating values*
- *List types, principles of operations, components and applications of steam turbines, steam generators, condensers, feed water and circulating water systems.*
- *Estimate different efficiencies associated with such systems*
- *Define terms and factors associated with power plant economics. Calculate present worth depreciation and cost of different types of power plants. Estimate the cost of producing power per kW.*

UNIT – 1**14 Hours**

STEM POWER PLANT: Different types of fuels used for steam generation, Equipment for burning coal in lump form, stokers, different types, Oil burners, Advantages of using pulverized fuel, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverised fuel furnaces, cyclone furnace, coal and ashhandling, generation of steam using forced circulation, high and supercritical pressures, A brief account of L. Mont Benson, Velox, Schmidt, Loeffler and ramson steam generator

UNIT – 2**10 Hours.**

CHIMNEYS: Natural, forced, induced and balanced draft, Calculations involving height of chimney to produce a given draft

Accessories for the steam generator such as super heaters, desuperheater, control of super heaters, Economisers, Air pre-heaters and re- heaters.

COOLING TOWERS AND PONDS : Different types of towers.

DIESEL ENGINE PLANT- ENGINES FOR POWER GENERATION: Method of starting diesel engines, Cooling and lubrication system for the diesel engine. Filters, centrifuges, Oil heaters, and exhaust system, Layout of a diesel power plant.

UNIT -3

12 Hours.

GAS TURBINE POWER PLANT: Advantages and disadvantages of the gas turbine plant, open and closed cycle turbine plants with the accessories

HYDRO-ELECTRIC PLANTS: Storage and pondage, flow duration and mass curves, hydrographs, Low, medium and high held plants, pumped storage plants, penstock, water hammer, surge tanks, gates and valves, power house, general layout. A brief description of some of the important hydel installation in India.

UNIT -4

12 Hours.

NUCLEAR POWER PLANT: Principles of release of nuclear energy fusion and fission reactions. Nuclear fuels used in the reactors. Multiplication and thermal utilization factors. Elements of the nuclear reactor , Moderator, control rod, fuel rods, coolants. Brief description of reactors of the following types – pressurized water reactor , boiling water reactor sodium graphite reactor, Fast breeder reactor, Homogeneous graphite reactor and gas cooled reactor, Radiation hazards, Shieldings, Radio active waste disposal

UNIT -5

12 Hours.

CHOICE OF SITE: For power station, load estimation, load duration curve, load factor, capacity factor, use factor, diversity factor, demand factor effect of variable of variable load on power plant, selection of the number and size of units

ECONOMIC ANALYSIS OF POWER PLANT: Cost of energy production. Selection of plant and generating equipment, performance and operating characteristics of power plants, tariffs for electrical energy.

ESSENTIAL READING:

1. Power Plant Engineering, P.K.Nag. Tata Mc Graw Hill 2nd ed 2001,.
2. Power Plant Engineering., Morse F.T. Van Nstrand.1998

RECOMMENDED READING:

1. Water Power Engg., Edition 3, Barrows, TMH, New Delhi. 1998
2. Plant Engg. Hand Book, Stanier, McGraw Hill. 1998
3. Hydraulic Machines, Jagadish Lal, Metropolititan Co 1996.
4. Principles of Energy Conversion, A.W.Culp Jr., McGraw Hill. 1996
5. Power Plant Technology, M.M. El-Wakil, McGraw Hill. International. 1994
6. Power Station Engg. Economics, Skrotizke and Vopat. 1994
7. Power Plant Engineering Domakundawar, Dhanpath Rai sons.2003.

ME833 NANOTECHNOLOGY**OBJECTIVE:**

- *Understand what nanotechnology is about and how to use it.*
- *Gain knowledge of*
 - o *structure, properties, manufacturing, and applications of silicon and carbon materials.*
 - o *fabrication methods in nanotechnology (top down & bottom up)*
 - o *characterization methods in nanotechnology (optical, electrical, AFM, SEM, TEM, and nanoindentation)*

UNIT - 1

AN OVERVIEW OF NANOSCIENCE & NANOTECHNOLOGY – historical background – nature, scope and content of the subject – multidisciplinary aspects – industrial, economic and societal implications.

EXPERIMENTAL TECHNIQUES AND METHODS for investigating and manipulating materials in the nano scale – electron microscope – scanning probe microscope – optical and other microscopes – light scattering – x-ray diffraction.

UNIT – 2**10 Hours.**

FULLERENES – discovery, synthesis and purification – chemistry of fullerenes in the condensed phase – orientational ordering – pressure effects – conductivity and superconductivity – ferromagnetism – optical properties.

Carbon Nanotubes – synthesis and purification – filling of nanotubes – mechanism of growth – electronic structure – transport properties – mechanical and physical properties – applications.

UNIT – 3**12 Hours.**

SELF-ASSEMBLED MONOLAYERS – monolayers on gold – growth process – phase transitions – patterning monolayers – mixed monolayers – applications.

GAS PHASE CLUSTERS – history of cluster science – formation and growth – detection and analysis – type and properties of clusters – bonding in clusters.

SEMICONDUCTOR QUANTUM DOTS – synthesis – electronic structure of nanocrystals – how quantum dots are studied – correlation of properties with size – uses.

UNIT – 4

12 Hours.

MONOLAYER-PROTECTED METAL NANOPARTICLES – method of preparation– characterization – functionalized metal nanoparticles – applications – superlattices.

CORE-SHELL NANOPARTICLES – types – characterization – properties – applications.

NANOSHELLS – types – characterization – properties – applications.

UNIT – 5

12 Hours.

NANO BIOLOGY – interaction between biomolecules and nanoparticle surfaces – materials used for synthesis of hybrid nano-bio assemblies – biological applications – nanoprobe for analytical applications – nanobiotechnology – future perspectives. **Nanosensors** – what make them possible – nanoscale organization for sensors – characterization – nanosensors based on optical properties – nanosensors based on quantum size effects – electrochemical sensors – sensors based on physical properties – nanobiosensors – sensors of the future.

NANOMEDICINES – approach to development – nanotechnology in diagnostic and therapeutic applications.

ESSENTIAL READINGS:

1. NANO: The Essentials – Understanding Nanoscience and Nanotechnology; T Pradeep (Professor, IIT Madras); Tata McGraw-Hill India (2007)
2. Nanotechnology: Richard Booker & Earl Boysen; Wiley (2005).

RECOMMENDED READING:

1. Introduction to Nanoscale Science and Technology [Series: Nanostructure Science and Technology], Di Venira, et al (Ed); Springer (2004)
2. Nanotechnology Demystified, Linda Williams & Wade Adams; McGraw-Hill (2007)
3. Introduction to Nanotechnology, Charles P Poole Jr, Frank J Owens, Wiley India Pvt. Ltd., New Delhi, 2007.

ME833 ORGANISATIONAL BEHAVIOUR & PROFESSIONAL COMMUNICATION**OBJECTIVES:**

- *To gain a solid understanding of human behavior in the workplace from an individual, group, and organizational perspective.*
- *To obtain frameworks and tools to effectively analyze and approach various organizational situations.*
- *To integrate course materials with your own workplace experiences.*
- *To reflect upon your own beliefs, assumptions, and behaviors with respect to how individuals, groups, and organizations act in order to expand your options of approaches and increase your own effectiveness.*

UNIT – 1**14 Hours.**

INTRODUCTION: Definition of Organization Behaviour and Historical development, Environmental context (Information Technology and Globalization, Diversity and Ethics, Design and Cultural, Reward Systems).

THE INDIVIDUAL: Foundations of individual behaviour, individual differences. Ability. Attitude, Aptitude, interests. Values.

UNIT – 2**14 Hours.**

LEARNING: Definition, Theories of Learning, Individual Decision Making, classical conditioning, operant conditioning, social learning theory, continuous and intermittent reinforcement.

PERCEPTION: Definition, Factors influencing perception, attribution theory, selective perception, projection, stereotyping, Halo effect.

UNIT – 3**12 Hours.**

MOTIVATION: Maslow's Hierarchy of Needs theory, Mc-Gregor's theory X and Y, Herzberg's motivation Hygiene theory, David Mc-Clelland's three needs theory, Victor Vroom's expectancy theory of motivation.

THE GROUPS: Definition and classification of groups, Factors affecting group formation, stages of group development, Norms, Hawthorne studies, group processes, group tasks, group decision making.

UNIT – 4**10 Hours.**

CONFLICT & STRESS MANAGEMENT: Definition of conflict, functional and dysfunctional conflict, stages of conflict process. Sources of stress, fatigue and its impact on productivity. Job satisfaction, job rotation, enrichment, job enlargement and reengineering work process.

UNIT – 5**10 Hours.**

PRINCIPLES OF COMMUNICATION: Useful definitions, communication principles, communication system, role of communication in management, barriers in communication, how to overcome the barriers, rule of effective communication.

ESSENTIAL READINGS:

1. Organizational Behaviour, Stephen P Robbins, 9th Edition, Pearson Education Publications, ISBN-81-7808-561-5 2002
2. Organizational Behaviour, Fred Luthans, 9th Edition, Mc Graw Hill International Edition, ISBN-0-07-120412-12002

RECOMMENDED READING:

1. Organizational Behaviour, Hellriegel, Srocum and Woodman, Thompson Learning, 9th Edition, Prentice Hall India, 2001
2. Organizational Behaviour, Aswathappa - Himalaya Publishers. 2001
3. Organizational Behaviour, VSP Rao and others, Konark Publishers.2002
4. Organizational Behaviour, (Human behaviour at work) 9th Edition, John Newstron/ Keith Davis. 2002

ME833 AUTOMOTIVE ENGINEERING**OBJECTIVES:**

- *To prepare students for successful careers in automotive and ancillary industry that meet the needs of Indian and multinational companies.*
- *To develop the ability among students to synthesized at and technical concepts for application to automotive design.*
- *To provide opportunity for students to work as part of teams on multidisciplinary projects.*
- *To provide students with a sound foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyse engineering problems and to prepare them for graduate studies.*
- *To promote student awareness of the life-long learning and to introduce the professional ethics and codes of professional practice.*

LEARNING OUT COME:

- *Will be able to implement specific advanced and emerging manufacturing technologies in modern industry.*
- *Will be able to describe the process of machining in various types of materials.*
- *Will describe the operations and utilization of lathe, drilling, milling, grinding machine, etc.*
- *Will describe the tool nomenclature, and design the tool for specific operations.*
- *Will apply merchant's analysis for tool wear, failure and life.*

UNIT - 1**ENGINE COMPONENTS AND COOLING & LUBRICATION SYSTEMS:**

Spark Ignition (SI) & Compression Ignition (CI) engines, cylinder - arrangements and their relatives merits, Liners, Piston, connecting rod, crankshaft, valves, valve actuating mechanisms, valve and port timing diagrams, Types of combustion chambers for S.I.Engine and C.I.Engines, Compression ratio, methods of a Swirl generation, choice of materials for different engine components, engine positioning, cooling requirements, methods of cooling,

thermostat valves, different lubrication arrangements.

FUELS, FUEL SUPPLY SYSTEMS FOR SI AND CI ENGINES: Conventional fuels, alternative fuels, normal and abnormal combustion, cetane and octane numbers, Fuel mixture requirements for SI engines, types of carburetors, C.D.& C.C. carburetors, multi point and single point fuel injection systems, fuel transfer pumps, Fuel filters, fuel injection pumps and injectors.

UNIT - 2

SUPERCHARGERS AND TURBOCHARGERS:

Naturally aspirated engines, Forced Induction, Types of superchargers, Turbocharger construction and operation, Intercooler, Turbocharger

IGNITION SYSTEMS: Battery Ignition systems, magneto Ignition system, Transistor assist contacts. Electronic Ignition, Automatic Ignition advance systems.

UNIT - 3

POWER TRAINS: General arrangement of clutch, Principle of friction clutches, Torque transmitted, Constructional details, Fluid flywheel, Single plate, multi-plate and centrifugal clutches. Gear box: Necessity for gear ratios in transmission, synchromesh gear boxes, 3, 4 and 5 speed gear boxes. Free wheeling mechanism, planetary gears systems, over drives, fluid coupling and torque converters, Epicyclic gear box, principle of automatic transmission, calculation of gear ratios, Numerical calculations for torque transmission by clutches.

UNIT - 4

DRIVE TO WHEELS: Propeller shaft and universal joints, Hotchkiss and torque tube drives, differential, rear axle, different arrangements of fixing the wheels to rear axle, steering geometry, camber, king pin inclination, included angle, castor, toe in & toe out, condition for exact steering, steering gears, power steering, general arrangements of links and stub axle, over steer, under steer and neutral steer, numerical problems, types of chassis frames.

SUSPENSION, SPRINGS AND BRAKES:

Requirements, Torsion bar suspension systems, leaf spring, coil spring, independent suspension for front wheel and rear wheel. Air suspension system. Types of brakes, mechanical compressed air, vacuum and hydraulic braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, Disk brakes, drum brakes, Antilock - Braking systems, purpose and operation of antilock-braking system, ABS Hydraulic Unit, Rear-wheel antilock & Numerical Problems.

UNIT - 5

AUTOMOTIVE EMISSION CONTROL SYSTEMS: Automotive emission controls, Controlling crankcase emissions, Controlling evaporative emissions, Cleaning the exhaust gas, Controlling the air-fuel mixture, Controlling the combustion process, Exhaust gas recirculation, Treating the exhaust gas, Air-injection system, Air-aspirator system, Catalytic converter, Emission standards- Euro I, II, III and IV norms, Bharat Stage II, III norms.

ESSENTIAL READINGS:

1. Automotive mechanics, William H Crouse & Donald L Anglin, 10th Edition
Tata McGraw Hill Publishing Company Ltd., 2007
2. Automotive Mechanics, S. Srinivasan, Tata McGraw Hill 2003.

RECOMMENDED READING:

1. Automotive mechanics: Principles and Practices, Joseph Heitner, D Van Nostrand Company, Inc
2. Fundamentals of Automobile Engineering, K .K. Ramalingam, Scitech Publications (India) Pvt. Ltd.
3. Automobile Engineering, R. B. Gupta, Satya Prakashan, 4th edn. 1984.
4. Automobile engineering, Kirpal Singh. Vol I and II 2002.

BTCY01 CYBER SECURITY**AIM**

This course is aimed at providing a comprehensive overview of the different facets of Cyber Security. In addition, the course will detail into specifics of Cyber Security with Cyber Laws both in Global and Indian Legal environments.

OBJECTIVES

Providing knowledge about different Cyber Crimes, Threats and Laws .Creating awareness about risk management and protection from the cyber threats.

UNIT I

Security Fundamentals-4 As Architecture Authentication Authorization Accountability, Social Media, Social Networking and Cyber Security.

Cyber Laws, IT Act 2000-IT Act 2008-Laws for Cyber-Security, Comprehensive National Cyber-Security Initiative CNCI – Legalities.

UNIT II

Cyber Attack and Cyber Services

Computer Virus – Computer Worms – Trojan horse.

Vulnerabilities - Phishing - Online Attacks – Pharming - Phishing – Cyber Attacks - Cyber Threats - Zombie- stuxnet - Denial of Service Vulnerabilities - Server Hardening-TCP/IP attack-SYN Flood.

UNIT III

Cyber Security Management

Risk Management and Assessment - Risk Management Process - Threat Determination Process - Risk Assessment - Risk Management Lifecycle.

Security Policy Management - Security Policies - Coverage Matrix

Business Continuity Planning - DisasterTypes - Disaster Recovery Plan - Business Continuity Planning Process.

UNIT-IV

Vulnerability - Assessment and Tools: Vulnerability Testing - Penetration Testing Black box-white box.

Architectural Integration: Security Zones - Devicesviz Routers, Firewalls, DMZ.

Configuration Management - Certification and Accreditation for Cyber-Security.

UNIT V

Authentication and Cryptography: Authentication - Cryptosystems - Certificate Services

Securing Communications: Securing Services - Transport – Wireless - Steganography and

NTFS Data Streams.

Intrusion Detection and Prevention Systems: Intrusion - Defense in Depth - IDS/IPS -IDS/IPS

Weakness and Forensic Analysis

Cyber Evolution: Cyber Organization - Cyber Future

RECOMMENDED READING

1. Matt Bishop, Introduction to Computer Security, Pearson, 6th impression, ISBN: 978-81-7758-425-7.
2. Thomas R, Justin Peltier, John, Information Security Fundamentals, Auerbach Publications.
3. AtulKahate, Cryptography and Network Security 2nd Edition, Tata McGrawHill.
4. Nina Godbole, SunitBelapure, Cyber Security, Wiley India 1st Edition 2011.
5. Jennifer L. Bayuk and Jason Healey and Paul Rohmeyer and Marcus Sachs, Cyber Security Policy Guidebook, Wiley; 1 edition , 2012, ISBN-10: 1118027809
6. Dan Shoemaker and Wm. Arthur Conklin, Cybersecurity: The Essential Body Of Knowledge, Delmar Cengage Learning; 1 edition (May 17, 2011) ,ISBN-10: 1435481690
7. Stallings, “Cryptography & Network Security - Principles & Practice”, Prentice Hall, 3rd Edition 2002.