

**B.Tech. (Sixth semester) Mechanical engineering**  
**ME 302 E Refrigeration and Air-Conditioning**

<b>L</b>	<b>T</b>	<b>P/D</b>	<b>Total</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>4</b>

**Theory: 100 Marks**  
**Sessional: 50 marks**

**Duration of Exam: 03 hours**

**(a) Refrigeration**

**UNIT I**

Basics of heat pump & refrigerator; Carnot's refrigeration and heat pump; Units of refrigeration; COP of refrigerator and heat pump; Carnot's COP; ICE refrigeration; evaporative refrigeration; refrigeration by expansion of air; refrigeration by throttling of gas; Vapor refrigeration system; steam jet refrigeration; thermoelectric cooling; adiabatic demagnetization.

Basic principles of operation of air refrigeration system, Bell-Coleman air refrigerator; advantages of using air-refrigeration in aircrafts; disadvantages of air refrigeration in comparison to other cold producing methods; simple air refrigeration in air craft; simple evaporative type air refrigeration in aircraft; necessity of cooling the aircraft.

**UNIT II**

Simple Vapor Compression Refrigeration System; different compression processes( wet compression, dry or dry and saturated compression, superheated compression); Limitations of vapour compression refrigeration system if used on reverse Carnot cycle; representation of theoretical and actual cycle on T-S and P-H charts; effects of operating conditions on the performance of the system; advantages of vapour compression system over air refrigeration system.

Methods of improving COP; flash chamber; flash inter cooler; optimum interstate pressure for two stage refrigeration system; single expansion and multi expansion processes; basic introduction of single load and multi load systems; Cascade systems.

Basic absorption system; COP and Maximum COP of the absorption system; actual NH<sub>3</sub> absorption system; functions of various components; Li-Br absorption system; selection of refrigerant and absorbent pair in vapour absorption system; Electro refrigerator; Comparison of Compression and Absorption refrigeration systems; nomenclature of refrigerants; desirable properties of refrigerants; cold storage and ice-plants.

**(b) Air conditioning**

**UNIT III**

Difference in refrigeration and air conditioning; Psychometric properties of moist air (wet bulb, dry bulb, dew point temperature, relative and specific humidity of moist air, temperature of adiabatic saturation); empirical relation to calculate  $P_v$  in moist air.

Psychometric chart, construction and use, mixing of two air streams; sensible heating and cooling; latent heating and cooling; humidification and dehumidification; cooling with dehumidification; cooling with adiabatic humidification; heating and humidification; by-pass factor of coil; sensible heat factor; ADP of cooling coil; Air washer.

**UNIT IV**

Classification; factors affecting air conditioning systems; comfort air-conditioning system; winter air conditioning system; summer air-conditioning system; year round air conditioning. unitary air-conditioning system; central air conditioning system; room sensible heat factor; Grand sensible heat factor; effective room sensible heat factor.

Inside design conditions; comfort conditions; components of cooling loads; internal heat gains from (occupancy, lighting, appliances, product and processes); system heat gain (supply air duct, A.C. fan, return air duct); external heat gain (heat gain through building, solar heat gains through outside walls and roofs); solar air temperature; solar heat gain through glass areas; heat gain due to ventilation and infiltration.

Transport air conditioning; evaporative condensers, cooling towers; heat pumps.

**References and Text books**

Refrigeration and air-conditioning by C.P arora

Basic Refrigeration and air-conditioning by Annanthana and Rayanan, TMG

Refrigeration and air-conditioning BY Arora and Domkundwar, Dhanpat rai

**NOTE: In the semester examination, the examiner will set 8 questions in all, at least two question from each unit, and students will be required to attempt only 5 questions, at least one from each unit.**

## **B.Tech. (Sixth semester) Mechanical engineering**

**ME 304 E**

### **TRIBOLOGY**

<b>L</b>	<b>T</b>	<b>P/D</b>	<b>Total</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>4</b>

**Theory: 100marks**  
**Sessional: 50 marks**  
**Duration of Exam: 03 hours**

#### **UNIT I**

Introduction to tribological systems and their characteristic features; analysis and assessment of surface; topography; deterministic and stochastic tribo-models for asperity contacts; techniques of surface examination; technological properties of surfaces.

Quantitative laws of sliding friction, causes of friction, adhesion theory, laws of rolling friction, measurement of friction

#### **UNIT II**

Introduction, mechanism of wear, types of wear, quantitative laws of wear, measurement of wear, wears resistance materials

#### **UNIT III**

Introduction, dry friction, boundary lubrication, hydrodynamic, hydrostatic and elasto-hydrodynamic lubrication, functions of lubricants, types and properties, lubricant additives.

Principles, application to rolling contact bearings, cams, Gears

#### **UNIT IV**

Geometry and pressure equation of journal bearing, hydrostatic bearings, thrust bearings, porous bearings and hydrodynamic gas bearings. Journal bearings with specialized applications. General requirements and different types of bearing materials.

#### **Suggested Reading**

Tribology in Indertrion- By Sushil Kumar Srivastava

Introduction to Tribology of Bearings- By B.C. Majumdar ; A.H.Wheeler

Principles of Tribology – By J. Halling, Macmillan

Mechanics and Chemistry in Lubrication- By Dorinson and Ludema , Elsevier

Friction and wear of Materials- By E. Robinowicz, Johan Wiley

Principles of Lubrication-By A. Cameron, Longmans

**NOTE: In the semester examination, the examiner will set 8 questions in all, at least two question from each unit, and students will be required to attempt only 5 questions, at least one from each unit.**

## **B.Tech. (Sixth semester) Mechanical engineering**

**ME 306 E**

### **MECHANICAL VIBRATION**

<b>L</b>	<b>T</b>	<b>P/D</b>	<b>Total</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>4</b>

**Theory: 100 Marks**

**Sessional: 50 marks**

**Duration of Exam: 03 hours**

#### **UNIT I**

Kinematics of simple vibrating motion, Simple harmonic motions, Vectorial representation of harmonic motion. Degree of freedom, Equations of motions, general solution of free vibration, Phase plane method

#### **UNIT II**

Damped free vibration, undamped and damped forced vibrations, Vibrating isolation, Vibrating instruments.

Undamped free vibration ,Principle modes , Influence coefficients, Coordinate coupling, Orthogonality, Vibration absorbers.

#### **UNIT III**

Geometric method, Stability of equilibrium points, Method of harmonic balance.

Influence coefficients, Dunkerleys equation, Matrix iteration, Holzer method, Rayleigh method, and Rayleigh-Ritz method.

#### **UNIT IV**

Transverse vibration of strings, Longitudinal vibrations of bars, Lateral vibration of beams, Torsional vibration of circular shafts, Whirling of shafts.

Introduction, Method of Laplace transformation and response to an impulsive output, response to step-input, pulse-input, and phase plane method.

#### **REFERENCE AND TEXT BOOKS: -**

Mechanical vibration - By G.K. Grover; Nemchand Chand and Sons

Mechanical Vibration – By Thomson; Prentice Hall

Mechanical Vibration - By Den Hartog; Mc Graw Hill

Introductory course to mechanical vibrations – By Rao and Gupta; Wiley Eastern

**NOTE: In the semester examination, the examiner will set 8 questions in all, at least two question from each unit, and students will be required to attempt only 5 questions, at least one from each unit.**

**B.Tech. (Sixth semester) Mechanical engineering**  
**ME 308 E COMPUTER AIDED DESIGN AND MANUFACTURING**

L	T	P/D	Total
4	1	-	5

**Theory: 100 Marks**  
**Sessional: 50 marks**  
**Duration of Exam: 03 hours**

**UNIT I**

Introduction to CAD/CAM, Historical Development, Industrial look at CAD/CAM, Introduction to CIM Basic of Geometric & Solid modeling, Coordinate systems, Explicit, Implicit, Intrinsic and parametric equation  
Part families, Part classification and coding, product flow analysis, Machine cell Design, Advantages of GT

**UNIT II**

Introduction, Transformation of points & line, 2-D rotation, Reflection, Scaling and combined transformation, Homogeneous coordinates, 3-D scaling, shearing, rotation, reflection and translation, combined transformations, Orthographic and perspective projections  
Algebraic and geometric forms, tangent & normal blending functions, reparametrization  
Straight line, conics, cubic splines, bezier curves and B-spline curves

**UNIT III**

Algebraic and geometric forms, tangent & twist vectors, normal blending function, reparametrization, Sixteen point form, four Curve form, Plane surface, ruled surface  
Surface of revolution, tabulated cylinder Bi-cubic surface, bezier surface, B-spline surface  
Solid models and representation scheme B-rep & CSG, sweep representation, Cell decomposition, spatial occupancy enumeration

**UNIT IV**

Introduction, fixed programmable and flexible automation, Types of NC systems, MCU & other components, Co-ordinate system, NC manual part programming, G & M codes, part program for simple parts, Computer assisted part programming  
Introduction, FMS component, Types of FMS, FMS layout, Planning for FMS, advantage and applications  
Introduction, conventional process planning, Steps in variant process planning, types of CAPP, planning for CAPP

**Suggested Reading:**

- ❖ CAD/CAM theory & practice (Ibrahim Zeid)
- ❖ CAD/CAM (Groover & Zimmer)
- ❖ Numerical control and computer aided manufacturing by RAO and Tiwari, Tmg

**NOTE: In the semester examination, the examiner will set 8 questions in all, at least two question from each unit, and students will be required to attempt only 5 questions, at least one from each unit.**

**B.TECH. (SIXTH SEMESTER) MECHANICAL ENGINEERING  
ME 310 E MACHINE DESIGN II**

<b>L</b>	<b>T</b>	<b>P/D</b>	<b>Total</b>
<b>2</b>	<b>-</b>	<b>6</b>	<b>8</b>

**Theory: 100Marks  
Sessional: 50 marks**

Duration of Exam: 04 hours

**UNIT I**

Classification of Gears; Selection of type; Law of Gearing, Standard system of Gear tooth, Various Failure modes, Interference, undercutting & minimum no. Of teeth  
Force Analysis, Beam strength of Gear tooth, Effective load on tooth, Estimation of module based on beam strength and wear strength, Gear lubrication, materials; Design Procedure, Gear Box design  
Terminology, Force Analysis, Virtual no. of teeth, Beam strength, Effective load, Wear strength  
Terminology, force analysis, beam strength & wear strength, effective load on gear tooth  
Terminology, properties, force analysis, friction, material selection

**UNIT II**

Design of flat belts & Pulleys, Design /selection of V belts & Pulleys, Design/selection of wire ropes, Design/selection of chains  
Single & multiple Plate clutch, Cone clutch  
External shoe brake, Internal shoe brakes

**UNIT III**

Coil Springs, Leaf Springs  
Hydro dynamically lubricated bearings, Selection of ball bearings, Selection of roller bearings, Selection of taper roller bearings  
Mechanism Design, Design of cam & Follower

**UNIT IV**

Design of Cylinder, Design of Piston, Design of Crank shaft, Design of connecting rod  
Design of Crane Hook  
Design of Flywheels

**SUGGESTED READING:**

- ❖ Design of Machine Elements      Bhandari                      TMH
- ❖ Machine Design                      Sharma Aggarwal      Katson Publishers
- ❖ PSG Design Data Book              PSG College of Engg      PSG Publication
- ❖ Machine Design an integrated Approach Robert I Norton, prentice hall
- ❖ Fundamental of machine component design R.C Juvinnal, Johan wiley& sons

**NOTE: In the semester examination, the examiner will set 8 questions in all, at least two question from each unit, and students will be required to attempt only 5 questions, at least one from each unit.**

**B. Tech. (Sixth semester) Mechanical Engineering**  
**FUNDAMENTALS OF MANAGEMENT**

**HUT-302E**

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Theory         : 100 Marks  
Sessionals     : 50 Marks  
Total            : 150 Marks  
Time             : 3 Hours

**UNIT – I     Financial Management**

Introduction of Financial Management, Objectives of Financial Decisions, Status and duties of Financial Executives. Financial Planning - Tools of financial planning. Management of working capital, Factors affecting requirements of working capital. Capital structure decisions. Features of appropriate capital structure. Sources of finance.

**UNIT-II     Personnel Management**

Personnel Management - Meaning, Nature and Importance; Functions of Personnel Management - (a) Managerial Functions and (b) Operative functions. Job Analysis: Meaning and Importance; Process of Job Analysis; Job Description and Job specification. Human Resource Development-Meaning and concept.

**UNIT-III    Production Management**

Production Management : Definition and Objectives  
Plant location : Ideal plant location. Factors affecting plant location.  
Plant Layout : Ideal plant layout, factors affecting plant layout.  
Work Measurement: Meaning, Objectives and Essentials of work measurement.  
Production Control: Meaning and importance of production control and steps involved in production control.

**UNIT-IV    Marketing Management**

Nature, scope and importance of marketing management. Modern Marketing concepts. Role of marketing in economic development. Marketing Mix. Marketing Information System. Meaning, nature and scope of International Marketing.

**NOTE :**

The question paper shall have eight questions in all organized into four sections, each section having two questions from each of the four units. The candidate shall have to attempt five questions in all, selecting at least one question from each unit.

**B.Tech. (Sixth semester) Mechanical engineering  
ME 312 E Refrigeration and Air Conditioning (Practical)**

<b>L</b>	<b>T</b>	<b>P/D</b>	<b>Total</b>
-	-	2	2

**Practical: 25Marks  
Sessional: 25 marks  
Duration of Exam: 03 hours**

**List of Experiments**

1. Study & Performance of basic vapour compression Refrigeration Cycle.
2. To find COP of water cooler.
3. To study the walk in cooler.
4. To study and perform experiment on vapour absorption apparatus.
5. Perform the experiment & calculate various. Performance parameters on a blower apparatus.
6. To find the performance parameter of cooling tower.
7. To study various components in room air conditioner.
8. To find RH of atmosphere air by using sling Psychometric and Psychometric.
9. To find performance of a refrigeration test rig system by using different expansion devices.
10. To study different control devices of a refrigeration system.
11. To study various compressor.
12. To find the performance parameters of Ice Plant.

**Note: Total Ten experiments must be performed. At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or outside the list.**

**B.Tech. (Sixth semester) Mechanical engineering**  
**ME 314 E TRIBOLOGY & MECHANICAL VIBRATION (PRACTICAL)**

<b>L</b>	<b>T</b>	<b>P/D</b>	<b>Total</b>
-	-	<b>2</b>	<b>2</b>

**Practical: 25Marks**  
**Sessional: 50 marks**

**Duration of Exam: 03 hours**

**LIST OF EXPERIMENT:**

1. To study undamped free vibrations of equivalent spring mass system and determine the natural frequency of vibrations
2. To study the free vibration of system for different damper settings. Draw decay curve and determine the log decrement and damping factor. Find also the natural frequency
3. To study the torsional vibration of a single rotor shaft system and to determine the natural frequency.
4. To determine the radius of gyration of given bar using bifilar suspension.
5. To verify the dunker ley's rule
6. To study the forced vibration of system with damping. Load magnification factor vs. Frequency and phase angle vs frequency curves. Also determine the damping factor.
7. To study the pressure distribution of a journal bearing using a journal bearing apparatus.
8. To determine the rate of wear of a metallic pin from the plot of displacement vs time curves by using friction and wear monitor apparatus.
9. To determine abrasion index of a material with the help of dry abrasion test rig.
10. To evaluate the load wear index and the weld point of a lubricant with the help of a four ball stream pressure tester.
11. To determine the two frequencies of torsional spring type double pendulum & compare them with theoretical values.
12. To determine the radius of gyration of a compound pendulum.
13. To determine the radius of gyration of disc using trifilar suspension.

**Note: Total Ten experiments must be performed. At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or outside the list.**



**B.Tech. (Sixth semester) Mechanical engineering**  
**ME 316 E COMPUTER AIDED DESIGN & MANUFACTURING (Practical)**

<b>L</b>	<b>T</b>	<b>P/D</b>	<b>Total</b>
-	-	2	2

**Practical: 25Marks**

**Sessional: 50 marks**

**Duration of Exam: 03 hours**

**List of Experiments**

Note: Practical will base on course No. ME 308 E.