# JABALPUR ENGINEERING COLLEGE, JABALPUR (MP)
## (An Autonomous Institute of Govt. of M.P. )
## Affiliated to Rajiv Gandhi Technological University, Bhopal (MP)
### Scheme of Study and Examination (w.e.f. July 2010)

**M.E. II Sem.** **Branch : Mech. Engg.** **Specialization : Heat Power**

| Course Code | Subject | Periods | | | EVALUATION SCHEME | | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | SESSIONAL EXAM | | | ESE | SUB TOTAL | |
| | | L | T | P | TA | CT | TOT | | | |
| ME-113 | Numerical Methods in Fluid Flow & Heat Transfer | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 4 |
| ME-114 | Control Theory & Systems | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 4 |
| ME-115 | Design of Heat Exchanger Equipments | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 4 |
| ME-116A | **Elective – I (Any One)** | | | | | | | | | |
| | Refrigeration Systems | | | | | | | | | |
| ME-1116B | Design of I.C Engines | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 4 |
| ME-116C | Application of F.E.M. to Thermal Engineering | | | | | | | | | |
| ME-117A | **Elective - II (Any One)** | | | | | | | | | |
| | Design of Air Conditioning Systems | 3 | 1 | - | 10 | 20 | 30 | 70 | 100 | 4 |
| ME-117B | Engine System Modeling and Analysis | | | | | | | | | |
| **(PRACTICAL/DRAWING/DESIGN)** | | | | | | | | | | |
| ME-118L | Numerical Methods in Fluid Flow & Heat Transfer Lab | - | - | 2 | 60 | - | 60 | 90 | 150 | 6 |
| ME-119L | Refrigeration Systems Lab | - | - | 2 | 60 | - | 60 | 90 | 150 | 6 |
| | **Total** | **15** | **5** | **4** | **170** | **100** | **270** | **530** | **800** | **32** |

T.A. Teachers Assessment, CT- Class Test, ESE - End Semester Examination, Total Marks 800
Total Periods : 24 Total Credits : 32

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## COURSE CONTENT & GRADE (w.e.f. July 2010)

| Branch | Subject Title | Subject Code | Grade for End Sem | | CGPA at the end of every even semester |
|---|---|---|---|---|---|
| | | | T | P | |
| | NUMERICAL METHODS IN FLUID FLOW AND HEAT TRANSFER | ME-113 | Min "D" | Min "D" | 5.0 |

## NUMERICAL METHODS IN FLUID FLOW AND HEAT TRANSFER

**INTRODUCTION:** ODE and their solutions, Classification of PDE's, Review of numerical methods.

**FIINITE DIFFERENCE METHOD:** Basics of FDM, Finite differences, Discretization, Consistency, Stability, Explicit and Implicit schemes, ADI Method, O-S Algorithm, Matrix Inversion, TDMA and G-S iterative technique.

**HEAT TRANSFER:** Review of equations governing heat transfer, Finite Difference applications in heat transfer, Conduction, free and forced convection.

**FLUID FLOW:** Review of equations governing fluid flow. Conservative and transportive properties, Artificial viscosity, Treatment of non--linearity, Solution of Boundary Layer Equation, N-S Equation.

Pre and Post processing, Presentation of Computational Data.

REFERENCE BOOKS:

1. Compuational Fluid Flow and Heat Transfer by K. Muralidhar & T Sundararajan (N arosa)
2. Computer Simulation of Flow and Heat Transfer by Ghosdastidar (TMH)

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|---|---|---|---|---|---|
| | | | T | P | |
| | CONTROL THEORY & SYSTEMS | ME-114 | Min "D" | Min "D" | 5.0 |

## CONTROL THEORY & SYSTEMS

**Unit 1: Introduction to Control systems & Components**

(a) Concept & classification, feedback & its characteristics.

(b) Block diagram representation of control systems and Terminology

(c) Servomechanisms regulators and process controllers.

(d) Mathematical models of physical systems: Differential equations of physical systems. Transfer function analysis.Signal flow graph and masons gain formula. Multivariable control systems.

(e) Components of control systems: Linear approximation of nonlinear systems. Potentiometers, synchros, servomotors, Tachometers, Stepper Motor, Accelerometer.

**Unit 2: Time Domain Analysis of Control Systems**

(a) Standard test signals, Time response of first and second order systems. Steady state error & error constants. Performance indices. Sensitivity.

(b) Stability: Concept, necessary conditions for stability: Routh criterion, Hurwitz criterion, relative stability analysis.

(e) Root Locus technique: Concept and properties of root Locus. Construction of root locus. Application of root locus technique, Root locus analysis,

(d) MATLAB: A tool for design and analysis of control systems.

**Unit 3: Frequency Domain Analysis of Control Systems**

(a) Correlation between time & frequency response. Frequency domain specifications, Bode plots, polar plots, bode stability analysis, closed loop frequency response.

(b) Nyquist stability analysis: Nyquist plot, Nyquist stability criterion, Relative stability,

**Unit 4:Digital Control System**

(a) Compensation of Control Systems : Compensating networks, lead compensation, lag compensation, lag-lead. compensation, feedback compensation. Compensation using bode plots, compensation using Root locus.

(b) State Variable Analysis: Concept of state variable and state model, state model for linear continuous time system, state variable and linear discrete time systems, digitalization.

**Unit 5: Industrial Automatic Controls**

(a) Automatic Control - Concept of industrial automatic control systems, Temperature, Pressure, Flow, Level & Speed control systems, comparators.

(b) Models of Control :- Two position control, proportional control, floating mode of control, rate mode of control , combination of controller modes, proportional plus reset controller.

(c) Controller Mechanisms: Pneumatic, hydraulic and electrical controllers.

Books Recommended:

1. Control systems engineering by Nagrath & Gopal.
2. Industrial automatic control by Millard H. Lajay.
3. Dynamic analysis & Feedback control by Ernest O. Doeblin.

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| Branch | Subject Title | Subject Code | Grade for End Sem | | CGPA at the end of every even semester |
|---|---|---|---|---|---|
| | | | T | P | |
| | DESIGN OF HEAT EXCHANGER EQUIPMENTS | ME-115 | Min "D" | Min "D" | 5.0 |

## DESIGN OF HEAT EXCHANGER EQUIPMENTS

Types of Heat Exchangers, Definitions & Quantitative relationships.

Analytical & Numerical solution procedures, Fouling Factors, Correction factors.

**Thermal & Hydraulic design of commonly used heat exchangers**: Double pipe Heat Exchanger, Shell & Tube Heat Exchanger, Condenser, Evaporator, Cooling and Dehumidifying coils, Cooling Towers, Evaporative Condenser, Design of Air Washer, Desert Coolers & Cooling Towers. Review of mechanical design, Codes (IEMA), Materials of construction, corrosion damage, Testing & Inspection, Casting.

**Heat Pipe:** Basics & its mathernatical model, Micro heat exchangers.

**Reference Books**

Heat transfer by : J P Holman
Engineering Heat & Mass Transfer by Sarit K Das
Compact Heat Exchangers by Kays & London
Refrigeration & Air Conditioning by W. F. Stoecker
ASHRAE Fundamental Hand Bok

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|---|---|---|---|---|---|
| | | | T | P | |
| | REFRIGERATION SYSTEMS | ME-116A | Min "D" | Min "D" | 5.0 |

## REFRIGERATION SYSTEMS

Introduction : Thermodynamics Properties Of Pure And Mixed Refrigerants And Their Selection.

Vapour Compression System, Actual Vapour Compression System, Deviation From Theoretical System, Multipressure System With Flash Chamber And Inter Cooling, Cascade System.

**Refrigeration Equipments**

**Compressors:** Analysis And Thermal Design Of Reciprocating, Centrifugal And Screw Compressors, Performance Characteristics & Capacity Control.

**Expansion Devices:** Capillary, Automatic And Thermostatic Expansion Valve.

**Other Equipments :** Liquid Receiver, Oil Separators, Liquid Line Strainers, Driers, Liquid Subcoolers.

**Condenser & Evaporator:** Types, Performance & Their Controls.

**Thermodynamics Of Refrigerant :** Absorbent Combinations, Analysis Of Simple And Industrial Vapour Absorption Systems Using Various Working Fluids, Solar Powered Refrigeration & Heat Pump.

**Books :**

1. Refrigeration & Air Conditioning by W.F.Stoecker
2. Refrigeration & Air Conditioning by C.P. Arora
3. Refrigeration & Air Conditioning by Manohar Prasad

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|---|---|---|---|---|---|
| | | | T | P | |
| | DESIGN OF AIR CONDITIONING SYSTEMS | ME-117A | Min "D" | Min "D" | 5.0 |

# DESIGN OF AIR CONDITIONING SYSTEMS

**Air Conditioning Heating and Cooling Loads:**

General procedure, Health and Comfort Criteria, Thermal Comfort, Air Quality, Procedures for estimating Heating and Cooling Load, Internal Heat Gains, System Heat Gains, Design conditions, Methodology & Equations for hour by hour load calculations.

**Air Conditioning System Planning** :

Procedure for analyzing Problem, Preliminary layout, Load Estimate, System Design, Check Figures, Zoning, Economics of Zoning, Zoning Methods.

**Air Conditioning Systems:**

Classification, Basic Central System, Central *AIC* System, Single & Multiple Zone Systems, All Air Systems, Air-Water Systems, All Water System, Unitary and Room Air Conditioners.

**Air Distribution. :**

Duct Layout, Air Distribution requirements & Methods. Outlets, Grills, & Registers - Their Performance, Selection, Location & Application, Air Distribution System Design.

**Air Duct Design:**
General System Design, Economic factor influencing, Duct Layout, Duct heat gain & Air leakage, Aspect Ratio, Circular equipments of rectangular Ducts, Friction losses, Equipment length representing other pipe losses Velocity Pressure, Fan Conservation loss or gain, General Rules, Duct Material. .

**Duct Design Method** : - Velocity Reduction Method, Equal Friction Method, Static Regain Method.

**System Noise & its Control** : - Noise, Generation of Noise, Sound Control & acceptable Sound level.

**Books :**


1. ASHRAE Fundamentals Handbooks.
2. Refrigeration & Air Conditioning by W. F. Stoecker & Jones.
3. Refrigeration & Air Conditioning by C. P. Arora.
4. Refrigeration & Air Conditioning by Manohar Prasad.
5. Modern Air Conditioning, Heating & Ventilating by W H Corrier, Cherne Grant & Roberts.
6. Heating, Ventilating & Air Conditioning, by McQuiston & Parker.


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|---|---|---|---|---|---|
| | | | T | P | |
| | Numerical Methods in Fluid Flow & Heat Transfer Lab | ME-118L | Min "D" | Min "D" | 5.0 |

### Numerical Methods in Fluid Flow & Heat Transfer Lab

The exercises in this component shall be designed to demonstrate the basic principles outlined in different units of the theory paper. After completing the exercises the student should have developed a good grasp of the practical utilities of the theory content.

**(Suggested Exercise)**

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|---|---|---|---|---|---|
| | | | T | P | |
| | Refrigeration Systems Lab | CE-119L | Min "D" | Min "D" | 5.0 |

### Refrigeration Systems Lab

The exercises in this component shall be designed to demonstrate the basic principles outlined in different units of the theory paper. After completing the exercises the student should have developed a good grasp of the practical utilities of the theory content.

**(Suggested Exercise)**

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