राष्ट्रीय प्रौद्योगिकी संस्थान रायपुर
National Institute of Technology Raipur
(Institute of National Importance)
G. E Road, Raipur-492010., (C.G.)

Phone: (0771) 2254200
Fax : (0771) 2254600
Website : www.nitrr.ac.in

Basic Structure of the 4 years B. Tech. Mechanical Engineering Program

Courses For Semester-VII (Year 4)`

National Institute of Technology Raipur (C.G.)													
Course of Study and Scheme of Examination									B. Tech. **VII Semester**				
S.No.	Board of Studies	Sub.Code	Subject Name	Periods/week			Examination Scheme					Total Marks	Credits L+(T+P)/2
				L	T	P	TA	FE	SE	T.C.A.	ESE		
1	Mech.Engg	ME 0701	Heat and Mass Transfer	3	1		20	15	15	50	70	**120**	4
2	Mech.Engg	ME 0702	Operation Research	3	1		20	15	15	50	70	**120**	4
3	Mech.Engg	ME 0703	Refrigeration & Air Conditioning	3	1		20	15	15	50	70	**120**	4
4	Mech.Engg	ME 0704	Elective-II	4	1		20	15	15	50	70	**120**	5
5	Mech.Engg	ME 0705	Heat and Mass Transfer Lab			3	30			30	20	**50**	2
6	Mech.Engg	ME 0706	Refrigeration & Air Cond. Lab			3	30			30	20	**50**	2
7			pract. Training				50			50	0	**50**	2
8			Minor Project			12	100			100	50	**150**	6
9			Seminar and Report Writing			2	50			50	0	**50**	1
			Total	**13**	**4**	**20**	**340**	**60**	**60**	**460**	**370**	**830**	**30**

* **TA- Teachers Assessment, FE- First Exam, SE- Second Exam, T. C. A- Total Continuous Assessment**

Note: For attendance of a student in every theory and practical class, the teachers are supposed to keep records ultimately in the following format which will be included in the semester mark-sheets.

Format for attendance			
Attendance			Category
>85	→	'G"	Good
>70 &<85	→	'F"	Fair
>60 &<70	→	'S"	Satisfactory
<60 & >45	→	'P"	Poor
<45	→	'V"	Very Poor

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DEPARTMENT OF MECHANICAL ENGINEERING
COURSE OUTLINE

Subject: Heat and Mass Transfer

Subject Code	**ME 0701**		
Semester	VII	Board of Studies	Mechanical Engg.
Maximum Marks	**70**	Minimum Marks	**25**
Type of course	Compulsory	Contact Hours	44
L+T+P	3+1	Credits	4
Prerequisite	Thermodynamics, Fluid Mechanics		

COURSE OUTCOME-
At the end of this course, the students will be able to

1. Distinguish different modes of heat transfer and solve steady state conduction problems.
2. Analyse finned surfaces and (assess how effectively and efficiently fins enhance heat transfer) solve transient heat conduction problems.
3. Apply convective heat transfer correlations (Forced and Natural convection) for external and internal flows.
4. Perform energy analysis on heat exchangers and obtain LMTD and effectiveness relations. Also, calculate mass-diffusion through plane layer under steady state conditions.
5. Indentify two-phase heat transfer and obtain relations for radiative heat transfer between surfaces.

SYLLABUS

UNIT-I
Introduction: Various modes of heat transfer, Fourier's, Newton's and Stefan Boltzman's Law, Combined modes of heat transfer, Thermal transfer, Thermal diffusivity, Overall heat transfer coefficient.
Conduction: The thermal conductivity of solids, Liquids and gases, Factors influencing conductivity measurement. The general differential equation of conduction, One dimensional steady state conduction, Linear heat flow through a plane and composite wall, Tube and sphere, Critical thickness of insulation, Effect of variable thermal conductivity, Conduction with heat generation in slab and cylinders, Spheres.

UNIT-II
Fins: Conduction convection system, Extended surfaces rectangular, Triangular, Circumferential and pin fins, General conduction analysis, Fins of uniform and non-uniform cross sectional area. Heat dissipated by a fin. Effectiveness and efficiency of fins, approximate solution, Design of fins for maximum heat transfer, Solution for different boundary condition, Use of fin analysis for measuring temperature error of Thermometer.

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Transient/Unsteady State Heat Conduction: System with negligible internal resistance, Lumped capacity method and its Validity. Unsteady state conduction through finite and semi- infinite slab without surface resistance, convection boundary conditions. Solution through Heisler`s chart.

UNIT-III

Forced Convection: Physical Mechanism of Forced Convection, Dimensional analysis for forced convection, velocity and Thermal Boundary layer, Flow over plates, Flow across cylinders and spheres, Flow in tubes, Reynold's analogy.

Natural Convection: Physical Mechanism of Natural Convection, Dimensional analysis of natural convection; Empirical relationship for natural convection.

UNT-IV

Two Phase Heat Transfer: Boiling heat transfer, Pool boiling, Boiling regimes and boiling curve, Next transfer correlations in pool boiling, Condensation heat transfer, Film condensation, Derivation for the average heat transfer coefficient 'h' for the case of laminar film condensation over vertical plate, Heat transfer correlation for inclined plates, Vertical tubes, Horizontal bank tubes.

Heat Exchangers: Different types of heat exchangers; Determination of heat exchanger performance, Heat exchanger transfer units, Analysis restricted to parallel and counter flow heat exchanger (LMTD and NTU method)

UNIT-V

Thermal Radiation: Introduction, absorption and reflection of radiant energy, Emission, Radiosity and irradiation, Black and non black bodies, Kirchhoff's law, Intensity of radiation, Radiation exchange between black surface, Geometric Configuration factor. Grey body relation exchange between surface of unit configuration factors, Electrical analogy to simple problems. on-luminous gas radiation. Errors in temperature measurement due to radiation.

Introduction to Mass Transfer: Mass and mole concentrations, Molecular diffusion, Eddy diffusion, Molecular diffusion from an evaporating fluid surface, Introduction to mass transfer in laminar and turbulent convection Combined heat and mass transfer, the wet and dry bulb thermometer.

Text Books:

1. Heat Transfer – S.P. Sukhatme – Tata McGraw Hill
2. Heat Transfer – J.P. Holman – Tata McGraw Hill
3. Heat transfer- C P Arora, Tata McGraw Hill

Reference Books:

1. Heat & Mass Transfer – K. Kannan – Anuradha Agencies
2. Heat Transfer – A Practical Approach–Yunus A. Cengel – McGraw Hill
3. Heat Transfer – Ghosh, Dastudhar – Oxford University Press
1. Heat & Mass Transfer – D. S. Kumar – S.K. Kataria & Sons.

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Subject: Operations Research

Subject Code	**ME 0702**	Subject Code	ME 0702
Semester	VII	Board of Studies	Mechanical Engg.
Maximum Marks	**70**	Minimum Marks	**25**
Type of course	Compulsory	Contact Hours	44
L+T+P	3+1+0	Credits	4
Prerequisite	Mathematics, Numerical Technique		

COURSE OUTCOME-

At the end of this course, the students are expected to be able to

1. Identify and develop operational research models from the description of the real system.
2. Apply the concepts of transportation problems, assignment problems, decision theory, game theory and simulation to solve the real life problems.
3. Assess the optimal decision in queuing theory, project Management Problems (CPM, PERT etc.)

SYLLABUS

UNIT I

Introduction: Definition and Development of Operations Research, Necessity and scope of OR in Industry, Operations Research in Decision making, Models in OR, Fields of application, Difficulties and Limitation of OR.

General Linear Programming Problems: Introduction, Maximization and minimization of function with or without Constraints, Formulation of a linear programming problem, Graphical method and Simplex method, Big M method, Degeneracy, Application of Linear Programming (LPP) in Mechanical Engineering.

UNIT – II

The Transportation Problems: Mathematical formulation, Stepping stone method, Modified Distribution Method, Vogel's Approximation Method, Solution of balanced and unbalanced transportation problems and case of Degeneracy.

The Assignment Problems: Mathematical formulation of assignment problems, Solution of assignment problems, Traveling salesman problems, Air crew Assignment problems.

UNIT - III

Waiting Line Theory: Basic queuing process, Basic structure of queuing models, Some commonly known queuing situations, Kendall's notation, Solution to M/M/1: ∞ /FCFS models.

Network Analysis: CPM/PERT, Network Representation, Techniques for drawing network, Resource smoothing and levelling, Project cost, Optimum project duration, Project crashing, Updating, Time estimation in PERT

UNIT – IV

Decision Theory and Game Theory: Decision making, Steps in decision theory approach,

Decision making under certainty, Uncertainty and under condition of risk, Decision Tree, Theory of Games, Two person zero sum game, Methods for solving two person zero sum game.

Simulation: Basic concept of simulation, Applications of simulation, Merits and demerits of simulation, Monte Carlo simulation, Simulation of Inventory system, Simulation of Queuing system.

Text Books:

1. Operation Research , Sasien Yaspan
2. Operation Research – N. D. Vohra – TMH
3. Operation Research– Hira & Gupta – S. Chand & Co.
4. Operation Research – H. Gillette – TMH, New Delhi
5. Operations Research – M. Taha – TMH, New Delhi
6. Fundamentals of Operation Research – Ackof Sasieni – Dhanpat Rai & Sons
7. Quantitative Approach to Management – Lovin and Krit Patrick – TMH
8. Operation Research– S.D. Sharma – S. Chand & Com. New Delhi.

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Subject: Refrigeration and Air Conditioning

Subject Code	**ME 0703**		
Semester	VII	Board of Studies	Mechanical Engg.
Maximum Marks	**70**	Minimum Marks	**25**
Type of course	Compulsory	Contact Hours	44
L+T+P	3+1+0	Credits	4
Prerequisite	Thermodynamics, Fluid Mechanics, Heat & mass Transfer		

COURSE OUTCOME-

At the end of the course the students will be able to:

1. Analyze Vapor Compression Refrigeration System and its performance, its evolution, modifications and evaluate effect of various parameters affecting the system.
2. Recommend Multi-stage compression and Multi Evaporator systems with different arrangement of expansion devices and intercooling arrangement including cascade systems.
3. Analyze Gas Cycle Refrigeration its evolution and different types and their comparison with Application in Aircraft Refrigeration.
4. Evaluate performance of Cooling Tower of various types with different flow control and energy saving strategies.
5. Design suitable indoor conditions for thermal comfort of human beings for any outdoor conditions with the understanding of psychrometry and various psychrometric processes.

SYLLABUS

UNIT-I

Refrigeration and second law of thermodynamics, Reversed Carnot Cycle. Its practical limitations, Standard Vapor compression Refrigeration System and its performance analysis. Effect of evaporator and condensing temperatures. Modifications, its effects, Liquid-to-Suction heat exchanger, Effect of Superheat and criteria For optimum superheat, Actual vapor compression refrigeration systems, Limitations of single stage.

UNIT-II

Multi-stage systems: Concept of flash gas removal using flash tank, inter cooling, with flash gas removal and inter cooling, use of flash tank for flash gas removal only, limitations of multi-stage systems. **Multi–Evaporator systems**: Applications, Comparison, advantages, Systems using single compressor and a pressure reducing valve with: Individual expansion valves & multiple expansion values, Systems with multi compression, inter cooling and flash gas removal, with individual compressors and multiple expansion valves, Cascade systems.

UNIT-III

Gas Cycle Refrigeration: Limitation of Carnot and reversed Carnot Cycle, Modified Cycle, Reversed Bell- Colemann, Actual Bell-Colemann Cycle, Application of Aircraft

Refrigeration, Different methods: Simple, Evaporative, Boot Strap, Boot Strap with evaporative, Reduced ambient, Regenerative and comparison of different air cooling system in Air Craft.

Cooling Tower: Types and performance evaluation, efficient system operation, Flow control strategies and energy saving opportunities, Assessment of cooling towers.

UNIT-IV

Psychrometry, estimating properties of moist air, psychrometry chart, Straight line law, adiabatic saturation and thermodynamic wet bulb temperature, psychrometer and the precautions, psychrometric processes and their representation, various psychrometric processes, equations for heat and mass transfer rates, Concept of SHF, By pass factor and ADP, Air washer and its use.

UNIT-V

Inside and Out Side Design Condition:

Fixing suitable indoor and outdoor design conditions, criteria , thermal comfort, metabolic rate, heat balance equation, equations for all modes of heat losses from the skin, thermo-regulatory mechanishm. Factors affecting thermal comfort, thermal indices, presents ASHRE comfort chart, Concept of Predicted Mean Vote (PMV) and percent of people Dissatisfied(PPD),criteria used for selecting outside design conditions and present typical summer design conditions.

Psychometric calculations, Simple summer air conditioning system with 100% re-circulated air, various summer air conditioning systems with ventilation and with zero and non zero by pass factor, with re-heat for high latent cooling load applications, Selection guidelines for supply air conditions.

Text Books:

1. Refrigeration And Air Conditioning by C.P. Arora,Tata McGraw-Hill
2. Refrigeration And Air Conditioning by R.K. Rajput Kaston Publication
3. Refrigeration And Air Conditioning by Arora & Domkundwar, Dhanpat raj Sons

Reference Books:

1. Refrigeration And Air Conditioning by stooker W.F.
2. Refrigeration And Air Conditioning by ahmadaul Ameen, PHI publication
3. Hand book of Air Conditioning and Refrigeration by Shan K.Wang, Tata McGraw-Hill

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Subject: Power Plant Engineering (Elective-II)

Subject Code			
Semester	VII	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Type of course	Elective	Contact Hours	55
L+T+P	4+1+0	Credits	5
Prerequisite	Applied Thermodynamics		

COURSE OUTCOME-

At the end of this course, the students are expected to be able to understand basic set up of

1. The steam power plant.
2. The Hydroelectric power plant.
3. The Nuclear power plant.
4. The Diesel power plant
5. Variable load problems and power station economics.

SYLLABUS

UNIT-I

General Sources of power, Importance of Central Power Stations, Types of power stations – steam, Nuclear, Diesel and hydro – Elements of modern power stations (Steams only) brief layout and arrangement of elements and complements, Sitting of different power stations, Foundation, Elements of Electric power systems primary and secondary distribution substations (in brief).

UNIT – II

Steam Power Plant: Steam power plants selection of working medium, Heat Balance in steam cycles, Heat rates, Comparison of efficiencies gas loop, Fuels and fuel handling System and Ash handling System, Air pre-heater, Feed water pre-heaters, Steam re-heaters, Dearators, Feed water treatment, Pumping and regulation water walls, Modern developments in steam boilers, Important instrumentation and piping of gas and water loop. Factors to be controlled from maximum efficiency and variable output.

UNIT – III

Hydro Electric power station – Potential power with reference to rainfall and catchments area, Water storage, Equipment used in hydro electric power stations, Characteristics of hydraulic turbines, Comparison of the factors governing the cost of hydro steam and diesel power stations.

Diesel power station – Application of Diesel in power field, Suitability of diesel engines for bulk power, Layout of Diesel Power Plant, Advantages and limitations of diesel, Power stations, Performance Characteristics.

UNIT – IV

Nuclear Power Station: Evolution of nuclear energy from atoms by fission and fusion, Chain reactions, Fission materials, Types of reactors, gas cooled, Boiling water liquid, Metal cooled and fast reactor,

Arrangements of various elements in a nuclear power station, Steam cycles and boilers coolant heat exchangers, Reactor control, Reactor shielding and safety methods.

UNIT – V

Variable load problems: Idealized and realized load curves, Effect of variable load on plant design and operation variable load operation and load dispatch.

Power station Economics: Source of income, Cost of plant and production, Elements of cost, depreciation and replacement theory of rates.

Text Books:

1. Power Plant Engineering, 2nd Edn. – P.K. Nag – Tata McGraw-Hill Pub. Com., New Delhi, 2004
2. A Text Book of Power Plant Engineering – R.K. Rajput – Laxmi Publications
3. A Course in Power Plant Engineering – Arora, Domkundwar – Dhanpat Rai & Co., 2005

Reference Books:

1. Power Plant Engineering – F. T. Morse Affiliated East – West Press Pvt. Ltd., New Delhi.
2. Power Plant Technology – M. M. E1 – Wakil – McGraw Hill, International Edition 1984
3. Power Plant Engineering – G. R. Nagpal – Khanna Publishers.
4. Fundamental of Power Plant Engineering -R. Yadav-Central Publishing House Allahabad,2011