RAJIV GANDHI UNIVERSITY OF KNOWLEDGE TECHNOLOGIES BASAR

B.Tech in Mechanical Engineering

COURSE STRUCTURE& SYLLABUS

IV Year – I Semester

S.No.	Subject Code	Subject Name	L	T	P/D	C
1	ME4101	Applied Thermodynamics-II	3	1	---	4
2	ME4102	CAD/CAM	3	1	---	4
3	ME4103	Refrigeration and Air Conditioning	3	1	---	4
4	ME4700	Project –I	---	---	8	4
5	ME44__	Elective-I	3	1	---	3
6	ME4701	Applied Thermodynamics Lab	---	---	3	2
7	ME4702	CAD/CAM Lab	---	---	3	2
8	ME4703	Automation and Robotics Lab	---	---	3	2
		Total	**12**	**3**	**17**	**25**

CODE: ME4101 APPLIED THERMODYNAMICS – II

Instruction	:4Hours/Week(3Theory + 1 Tutorial)
Duration of External Exam	: 3 Hours
Scheme of External Exam	: 60 Marks
Scheme of Internal Exam	: 40 Marks
Credits	: 4

Course Educational Objectives:

- To understand the applied thermodynamic concepts, the construction and the working principles of various engineering devices such as steam generators, steam nozzles, steam turbine, I.C. engines and gas turbines.

Course Outcomes:

Students undergoing this course are able to

- Apply basic knowledge of the principles of thermal systems.
- To apply the thermodynamic concepts into various thermal application like IC engines, Steam Turbines, Compressors and Refrigeration and Air conditioning systems.

UNIT – I

Basic Concepts: Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration – reheating- combined- cycles.

Boilers : Classification based on Working principles & Pressures of operation -L.P & H.P.Boilers – Mountings and Accessories – Boiler horse power, equivalent evaporation, efficiency and heat balance – **Draught**: classification – Height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced draught.

UNIT – II

Steam Nozzles: Function of nozzle – applications - types, Flow through nozzles, thermodynamic analysis – assumptions –velocity of nozzle at exit-Ideal and actual expansion in nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio. Criteria for design of nozzle shape: Super saturated flow, its effects, degree of super saturation and degree of under cooling - Wilson line –Shock at the exit.

UNIT – III

Impulse turbine; Mechanical details – Velocity diagram – effect of friction – power developed, axial thrust, blade or diagram efficiency – condition for maximum efficiency. De-Laval Turbine - its features. Methods to reduce rotor speed-Velocity compounding and pressure compounding, Velocity and Pressure variation along the flow – combined velocity diagram for a velocity compounded impulse turbine. Governing of impulse turbine.

Reaction Turbine: Mechanical details – principle of operation, thermodynamic analysis of a stage, degree of reaction –velocity diagram – Parson's reaction turbine – condition for maximum efficiency. Governing of reaction turbine.

UNIT IV

Steam Condensers : Requirements of steam condensing plant, rare fraction – Classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency – air leakage, sources and its effects, air pump- cooling water requirement.

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UNIT – V

Gas Turbines : Simple gas turbine plant – Ideal cycle, essential components – parameters of performance – actual cycle – regeneration, inter cooling and reheating –Closed and Semiclosed cycles – merits and demerits, Brief concepts about compressors, combustion chambers and turbines of Gas Turbine Plant.

Jet Propulsion : Principle of Operation –Classification of jet propulsive engines – Working Principles with schematic diagrams and representation on T-S diagram - Thrust, Thrust Power and Propulsion Efficiency – Turbo jet engines –Turbo jet, Turbo prop, Pulse jet – Schematic Diagram, Thermodynamic Cycle, Performance Evaluation Thrust Augmentation – Methods. Introduction to Rocket propulsion.

TEXT BOOKS:

1. Thermal Engineering / R.K. Raj put / Lakshmi Publications
2. Basic and Applied Thermodynamics / P.K. Nag/TMH

REFERENCES:

1. Gas Turbines – V.Ganesan /TMH
2. Thermodynamics and Heat Engines / R. Yadav / CentralBook Depot
3. Gas Turbines and Propulsive Systems – P.Khajuria &S.P.Dubey - /Dhanpatrai
4. Thermal Engineering-R.S Khurmi/JS Gupta/S.Chand.
5. Thermal Engineering-M.L.Mathur & Mehta/Jain bros.
6. Thermal Engineering Data Book – B. S. Reddy and K. H. Reddy / I.K. International

CODE: ME4102 CAD/CAM

Instruction	:4Hours/Week(3Theory + 1 Tutorial)
Duration of External Exam	: 3 Hours
Scheme of External Exam	: 60 Marks
Scheme of Internal Exam	: 40 Marks
Credits	: 4

Objectives:

- To help the students in understanding the functioning of computer numerical control machine tools and also in writing programs for operating this machines.
- To help the student in understanding advanced manufacturing concepts like Group technology, flexible manufacturing systems, Computer aided Process Planning, Computer aided quality control, Artificial Intelligence etc.

Unit-I

CAD Fundamentals: Classification and basic elements of CAD work station hardware, Hardware integration and networking. CAD Software: Definitions of system software and application software. Graphic Standards and Exchange Formats. CAD database and structure.

Automatic 2-D facilities such as Fillets, Chamfers, Hatching, Dimensioning, Editing, Windowing & Zooming. 2-D & 3-D Geometric Transformations.

Unit-II

Geometric modeling: 3-D wire frame modeling: wire frame entities and their definitions, Interpolation and approximation of curves, synthetic curves and curve fitting. Definitions of cubic, Bezier, and B-spline curves.

Surface modeling: Definitions of basic surfaces, surface of revolution, blends, intersection, and Cubic, Bezier, B-spline surfaces.

Solid Modeling: Solid entities, Boolean operations, B-rep and C-rep approaches. Feature based modeling: Concepts and applications, Assembly modeling.

Finite element modeling: Introduction, modeling, Meshing, Characteristics of different elements, different solvers and post processing.

Unit-III

Numerical Control of machine Tools: Features and elements of NC. Positional, paraxial and contouring types. Definitions of axes, punched type, formats of tape preparation. Definitions of interpolation, post-processor, preparatory and miscellaneous functions, canned cycles, tool length and cutter radius compensation. Manual and computer aided part programming (APT) for simple components. Programming with MACROS.

Unit-IV

Computer Control in NC and Robots: Machining centers, CMC, DNC and adaptive control systems. Their types, typical configurations and relative features.

Industrial Robots: Classification based on manipulator configurations, relative characteristics, Online and offline programming methods, controls and drives, applications.

Unit-V

Group Technology: Organization, G.T. layout, part classification and coding, CAPP: Variant and Generative approaches and their relative features.

Computer Aided Quality Control: Computer in quality control, Contact and non contact inspection, optical and non optical computer aided testing.

Others: Basic concepts of FMS, Experts systems. Artificial intelligence, Typical Applications of computer in manufacturing viz. management, in-process measurement, CAD/CAM integration.

Suggested Reading

1. Ibrahim Zeid, "CAD/CAM, theory and practice", McGraw Hill Inc, N.Y.1991.

2. Grover, MP and Zimmers E.W., "CAD/CAM", Prenctice Hall of India 1989.

3. Rao P.N., Tiwari N.K., Kundra T.K., "Computer Aided Manufacturing", Tata McGraw Hill, New Delhi, 1993.

4. Radhakrishnan. P, Subramanyan. S, Raju. V, "CAD/CAM/CIM", New Age international (P) Ltd., 2nd Edn., 2004.

REFERENCES:

1. Automation, Production systems & Computer integrated Manufacturing, Groover,P.E
2. CAD / CAM / CIM , Radhakrishnan and Subramanian, New Age
3. Principles of Computer Aided Design and Manufacturing , Farid Amirouche, Pearson
4. CAD/CAM Theory and Practice, R. Sivasubramaniam, TMH
5. Computer aided design and manufacturing, Lalit Narayan/ PHI.

CODE: ME4103 REFRIGERATION AND AIR CONDITIONING

Instruction	:4Hours/Week(3Theory + 1 Tutorial)
Duration of External Exam	: 3 Hours
Scheme of External Exam	: 60 Marks
Scheme of Internal Exam	: 40 Marks
Credits	: 4

Course Educational Objectives:

- To enable the students to understand the various types refrigeration and air conditioning systems
- To create confidence to solve complex problems in the field refrigeration and air conditioning
- To provide knowledge on various refrigeration cycles, system components and refrigerants.

Course Outcomes:

Students undergoing this course are able to

- Perform calculations relating to heat exchangers, refrigeration and air conditioning cycles.
- Apply knowledge on various refrigeration cycles, system components and refrigerants to design refrigeration and air-conditioning systems.
- Understanding of factors which affect energy efficiency and total environmental warming impact.

UNIT I : REFRIGERATION SYSTEM 9

Introduction to Refrigeration system : Necessity and applications – Unit of refrigeration and C.O.P. Mechanical Refrigeration – Types of Ideal cycles of refrigeration. Air Refrigeration: Bell Coleman cycle and Brayton Cycle, Open and Dense air systems – Actual air refrigeration system problems Refrigeration needs of Air crafts.

UNIT II :VAPOUR COMPRESSION AND ABSORPTION REFRIGERATION 9

Vapour compression refrigeration – working principle and essential components of the plant simple Vapour compression refrigeration cycle – COP – Representation of cycle on T-S and p h charts effect of sub cooling and super heating – cycle analysis – Actual cycle Influence of various parameters on system performance – Use of p-h charts – numerical Problems

Vapor Absorption System – Calculation of max COP – description and working of NH3 water system and Li Br –water (Two shell & Four shell) System. Principle of operation Three Fluid absorption system, silent features

UNIT III SYSTEM COMPONENTS **9**

System Components : Compressors – General classification – comparison – Advantages and Disadvantages. Condensers classification Working Principles Evaporators classification Working Principles Expansion devices Types Working Principles Refrigerants – Desirable properties – classification refrigerants used – Nomenclature – Ozone Depletion Global Warming

UNIT IV AIR CONDITIONING **9**

Introduction to Air Conditioning Review of fundamental properties of psychometric – use of sychometric charts – psychometric processes – Grand and Room Sensible Heat Factors – by pass factor – requirements of comfort air conditioning –factors governing optimum effective temperature, recommended design conditions and ventilation standards. Concept of ESHF and ADP Requirements of human comfort and concept of effective temperature- Comfort chart – Comfort Air conditioning – Requirements of Industrial air conditioning, Air conditioning Load Calculations.

UNIT V AIR CONDITIONING SYSTEMS AND HEAT PUMP **9**

Air Conditioning systems - Classification of equipment, cooling, heating humidification and dehumidification, filters, grills and registers, fans and blowers. Heat Pump – Heat sources – different heat pump circuits, air conditioning applications

TOTAL: 45periods

TEXT BOOKS:

1. Arora C. P., Refrigeration and Air Conditioning, Tata McGraw Hill.2010
2. Ballany P.L., Refrigeration and Air Conditioning, Khanna Publications,2009

REFERENCE BOOKS:

1. Domkundwar, Refrigeration and Air Conditioning, Dhanpat Rai,2010
2. Ashrae Hand Book', 4 Vol., Current Ed., Carrier Air Conditioning Co., 'Hand Book of Air Conditioning', Prentice Hall of India, 1982
3. Basic Refrigeration and Air Conditioning**,** Tata McGraw-Hill Education, Apr-2005.

URL:

1. http://en.wikipedia.org/wiki/Refrigeration

2. http://www.youtube.com/watch?v=b527al9D_rY

3. http://home.howstuffworks.com/refrigerator4.htm

BEYOND THE SYLLABUS:

1.HVAC system
2.More depth in P-H Problems
3. Alternative Refrigerants
4. cryo systems

CODE: ME44__ ELECTIVE-I

Instruction	:4Hours/Week(3Theory + 1 Tutorial)
Duration of External Exam	: 3 Hours
Scheme of External Exam	: 60 Marks
Scheme of Internal Exam	: 40 Marks
Credits	: 3

Soft Computing (ME 4401)

Introduction, Optimization and Some Traditional Methods, Introduction to Genetic Algorithms, Some Specialized Genetic Algorithms, Introduction to Fuzzy Sets, Fuzzy Reasoning and Clustering, Fundamentals of Neural Networks, Some Examples of Neural Networks, Combined Genetic Algorithms: Fuzzy Logic, Combined Genetic Algorithms: Neural Networks, Combined Neural Networks: Fuzzy Logic.

Composite materials (ME 4402)

Introduction: materials, fiber reinforcement, matrix materials; Manufacturing processes: hand lay-up, prepeg lay-up, bag molding, autoclave processing, compression molding, resin transfer molding, pultrusion, filament winding, micro-mechanics: strength of materials approach, continuum approach; Ply mechanics: co-ordinate systems, off-axis stiffness; Macro-mechanics: description of laminates, laminate moduli, computation of stresses in laminates, types of joints. Failure criteria, Smart composites : active fiber composites, introduction to smart composite structures.

Mechanical handling systems and equipments (ME 4403)

Introduction to various Mechanical Handling Systems and Equipment for handling unit load and bulk materials, namely Pulley blocks, Winches, Electric Hoists, EOT Cranes, Belt Conveyor, Bucket Elevator, Screw conveyor and Pneumatic Conveyor etc. Dynamic analysis ,design procedures of their components, common mechanisms involved. and their industrial applications. Programmable and Flexible load handling devices.

Advanced Fluid Mechanics (ME 4421)

Concept of continuum and definition of a fluid. Body and surface forces, stress tensor. Scalar and vector fields, Eulerian and Lagrangian description of flow. Motion of fluid element - translation, rotation and vorticity; strain rate tensor, continuity equation, stream function and velocity potential. Transport theorems, Constitutive equations, derivation of Navier-Stokes equations. Exact solutions of Navier-Stokes equations: plane Poiseuille flow and Coutte flow, Hagen-Poiseuille flow, flow between two concertic rotating cylinders, Stoke’s first and second problem,

Hiemenz flow, flow near a rotating disk, flow in convergent-divergent channels. Slow viscous flow: Stokes and Oseen's approximation, theory of hydrodynamic lubrication. Boundary layer: derivation, exact solutions, Blasius, Falkner Skan, series solution and numerical solutions. Approximate methods. momentum integral method. Two dimensional and axisymmetric jets. Description of turbulent flow, velocity correlations, Reynold's stresses, Prandtl's Mixing Length Theory, Karman's velocity defect law, universal velocity distribution. Concepts of closure model and wall function, K-e model of turbulence.

Design optimization (ME 4441)
Basic Concepts ; Functions of One variable : Polynomial Approximations, Golden Section Method, Finding Bounds on the Solution ; Constrained Functions of One Variable : Direct and Indirect Approaches ; Unconstrained Functions of Many Variables : Zero-order, First-order and Second-order Methods, Scaling of Variables and Constraints, Convergence Criteria ; Constrained Functions of Many Variables : Linear Programming, Sequential Unconstrained Minimization Techniques, Direct Methods ; Approximation Techniques ; Duality ; General Design Applications.

Simulation of mechanical systems (ME 4442)
Energy Methods and variational principles. Euler-Lagranges equation for discrete and continuous systems. Hamiltons principle. Analysis of constraints - non-holonomic systems. Integration of system equations. Modelling in multi-energy domain through bond graphs. Modelling of a system of rigid bodies, structural systems, Hydraulic systems, Thermal systems, electronic and mechatronic systems. Modelling systems for control strategies and design of control strategies in physical domain. Numerical prototyping as modelling for design and synthesis using computational tools like SYMBOLS, MATLAB, ADAMs, etc.

Tribology (ME 4443)
Definition of Tribology. Economic aspects of Tribology (Lubrication, Friction and Wear). Basic equations of the theory of lubrication, its solution for idealized and finite bearings. Calculations of the flow rate. Thermal equilibrium. Bearing design. Design and selection of anti friction bearings. Theories of friction ,wear and their measurement.

Operation Research – I (IM 4461)
Behavioural versus quantitative decision making, role of models. Linear programming, Graphical and simplex procedure, Sensitivity analysis; Transportation and Assignment problems, Application of linear programming in business and other systems, Integer linear programming, Cutting plane algorithm and branch and bound methods. Introduction to queuing, single and multiple server models, finite population models, queuing costs and applications.

Engineering Economy Costing & Accounting (IM 4462)

Engineering economy: equivalence, time value, present value and annual equivalent cost, rate of return, replacement analysis, evaluation of public activities, generation and evaluation of alternatives in engineering situations, projects, replacement and inventory.

Accounting: Financial statements, double entry bookkeeping. Costing: cost concepts, material, labour and overhead costs, overhead allocations and absorption, introduction to job costing, process costing, marginal costing, and standard costing, relevant costs for decision making, cost control and cost reduction.

Production Planning & Control (IM 4464)

Demand forecasting: Long and Short-term demand forecasting methods, Regression analysis and smoothing methods, Estimation of trend, cycle, and seasonality components, Analysis of forecast error and computer control of forecasting systems.

Production-distribution system design: Plant location and capacity scheduling, Multiple plant production facility design. Aggregate planning and master production scheduling, Aggregation techniques, Aggregate capacity scheduling, Disaggregation of aggregate plan.

Master production scheduling: Analytical and computer integrated solution techniques, Operations scheduling and control: Basic sequencing and scheduling techniques, Dispatching rules, Progress chasing and Updating of production schedules. Design of production planning and control systems: system design for continuous and intermittent production systems, Integration of master production, Material requirement and Shop scheduling systems.

Management of Inventory Systems (IM 4465)

Role of inventory in effective operation of production, distribution and maintenance systems. Forms of inventory, Role of inventory, Interaction of inventory with other systems like marketing, finance and production. Estimation of demand. Dependent and independent demand items. Forecast of demand for slow and fast-moving demand items. Materials requirements planning. Determination of inventory systems: Economic order quantity. Determination of continuous and discrete demand situations. Quantity discount, Joint ordering, Exchange curve analysis, and Coverage analysis for multi-items. Probabilistic inventory systems: perpetual and periodic control systems. Safety stock and reorder point determination. Spare part inventory systems: control policy for slow moving spares, Repairable items and substitutable items. Multi-echelon inventory systems: multi-echelon inventory control by pull and push system types. METRIC and MODMETRIC methods. Stores management: item classification, coding, storing and retrieval, Issue policy, Inventory valuation and stock verification. Computer integrated stores management. Vendor relations and vendor evaluation: Vendor development, Vendor evaluation techniques. Joint ordering and delivery negotiations. Value analysis and standardisation. Variety reduction through standardisation. Substitution and design modification techniques. Value analysis and its applications.

CODE: ME4701 APPLIED THERMODYNAMICS LAB

Instruction	: 3 Hours/Week (3 Practical)
Duration of External Exam	: 3 Hours
Scheme of External Exam	: 60 Marks
Scheme of Internal Exam	: 40 Marks
Credits	: 2

List of experiments:

1. To study Vapour Compression Refrigeration cycle with the help of refrigeration circuit under variable load conditions
2. To determine the Coefficient of Performance, Refrigeration capacity & Compressor work of Vapour Compression Refrigeration cycle with the help of refrigeration circuit under variable load conditions
3. To study Vapour Absorption Refrigeration cycle
4. To determine the Coefficient of Performance, Refrigeration capacity & Compressor work of Vapour Absorption Refrigeration cycle
5. To compare heat transfer for different heating elements in a cross flow heat exchanger
6. To study fundamental principles and various controls used in room air conditioning
7. To study different psychometric processes and estimating the change of state of air using air conditioner and illustrating them on psychometric diagram
8. Study on the characteristics of flame stability and methods to improve stability limits
9. Determination of flame speed based on the cone method
10. Determination of the relationship between flame speed and air/fuel ratio
11. flame separation demonstration

CODE: ME4702 CAD/CAM LAB

Instruction	: 3 Hours/Week (3 Practical)
Duration of External Exam	: 3 Hours
Scheme of External Exam	: 60 Marks
Scheme of Internal Exam	: 40 Marks
Credits	: 2

Course Objectives:

- To understand the various features of geometric modeling packages like Creo(Pro-E) /CATIA/Solid Works like 2d-Sketching, Part Modeling and Assembly
- To understand the application of Finite Element Analysis packages like ANSYS/ NASTRAN/ADINA in solving structural and thermal problems
- To develop NC part program, simulate and manufacture components on CNCmachine

Computer Aided Design

1. Introduction to various features of geometric modeling packages like: Creo (Pro-E) /CATIA/Solid Works.
2. Practicing problems on 2D-Sketching.
3. Practicing problems on Part Modeling
4. Practicing problems on Assembly Modeling.
5. Static Structural Analysis using 2D truss/beam/etc. for different types of loads using ANSYS/NASTRAN/ADINA etc.
6. Steady state heat transfer and transient heat transfer analysis.

Computer Aided Manufacturing

7. Development of CNC part program for turning, facing, step turning, taper turning etc with and without canned or fixed cycle.
8. Tool path simulation using any CAM software
9. Demonstration of manufacturing of simple parts on CNC machine
10. Programming for simulation of integrating various machines, robots and material handling equipment using plant layout simulation software like FlexSim/Arena/Promodel etc.

CODE: ME4703 AUTOMATION AND ROBOTICS LAB

Instruction	: 3 Hours/Week (3 Practical)
Duration of External Exam	: 3 Hours
Scheme of External Exam	: 60 Marks
Scheme of Internal Exam	: 40 Marks
Credits	: 2

Objectives:

- To understand basic experiments related to robot programming and CNC programming
- To understand basic experiments related to wire EDM and CMM Machines

Experiments:

1. Experiments using wire EDM machine
2. Experiments using CMM machine
3. Experiments using Robotic arm machine
4. Experiments using CNC lathe machine
5. Experiments using TIG and MIG welding machines