



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Shri Rawatpura Sarkar University, Raipur



Examination Scheme & Syllabus for B.Tech in Mechanical Engineering Semester-VII

(Effective from the session: 2022-23)



**SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
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**Four Years B.Tech. Programme
Scheme of Teaching and Examination
B.Tech. Seventh Semester Mechanical Engineering
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the session: 2022-23)**

S.N	Course Code	Course Title	Hours per week			Credit	Examination Scheme			Sem End Exam Duration (Hrs)
			L	T	P		Continuous Evaluation	Sem End Exam	Total	
1.	BENME701T	Automobile Engineering	3	1	-	4	30	70	100	3
2.	BENME701P	Automobile Engineering-Lab	-	-	3	2	15	35	50	-
3.	BENME702T	Refrigeration & Air-conditioning	4	1	-	4	30	70	100	3
4.	BENME702P	Refrigeration & Air-conditioning-Lab	-	-	3	2	15	35	50	-
5.	BENME703T	Computer Aided Design & Manufacturing	4	1	-	4	30	70	100	3
6.	BENME703P	Computer Aided Design & Manufacturing Lab	-	-	3	2	15	35	50	-
7.	BENME704T	Machine Tool Technology	4	1	-	4	30	70	100	3
8.	BENME705T	Professional Elective-II	4	1	-	4	30	70	100	3
9.	BENME706P	Minor Project/seminar	4	1	4	6	100	50	150	-
		TOTAL				32			800	

L – LECTURE, T- TUTORIAL, P- PRACTICAL, EX-EXAM, IN- INTERNAL, TC- TOTAL CREDIT, Th- THOERY, Pr- PRACTICAL

List of Electives-I

S.No.	Subject	Subject Code
I	Quality Control & Total Quality Management	BENME705A
II	Product Design & Development	BENME705B
III	Thermal System Design	BENME705C



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Course Title	AUTOMOBILEENGINEERING				
Course Code	BENME701T				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Understanding of basic concept of machine design, internal combustion engine, kinematics of machine and fluid mechanics.				
Course Objectives	This course will enable students to: <ul style="list-style-type: none">• Understand the basic structure of an automobile• Understand construction of suspension system• Understand transmission system and its elements• Understand braking system, steering system and electrical system				
Course Contents	UNIT – I Vehicle structure: Type of automotive vehicles, general layout, vehicle construction-chassis, frame and body, types of frames, frameless and unitary construction, position of power unit. Suspension system: Objects & principles of suspension, system, types, rigid axle suspension & Independent suspension for front & rear ends, simple & double arm parallel & perpendicular type of suspension system. Gas filled suspension system. Springs: Purpose, types viz. leaf, coiled, rubber, air, suspension system, torsion bar, stabilizer, telescopic damper. UNIT – II Clutches: Characteristics, functions, principles of operation of clutch, friction clutch, single-plate, multi-plate, centrifugal clutch, positive clutch, friction plate clutch lining materials. Torque transmitted and related problems.				



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	<p>Fluid flywheel:Construction, working principles & characteristics.</p> <p>UNIT – III</p> <p>Gear Box:Object of Gear Box, air, rolling & gradient resistance, tractive effort variation with speed, performance curve.</p> <p>Types of Gear Boxes:Sliding mesh, constant mesh, synchromesh device, automatic transmission, overdrive, lubrication of gear box.</p> <p>Torque Converter: Principles of working, characteristics, Torque converter with direct drive. Testing of Automobiles.</p> <p>UNIT – IV</p> <p>Universal Joint:Types, propeller shaft, slip joint.</p> <p>Differential:Functions, single & double reduction differential, limited slip differential.</p> <p>Front Axle:Live& dead axle, stub axle.</p> <p>Back Axle:Hotchkiss drive, torque tube drive.</p> <p>Tyres:Types specification, causes of tyre wear & rim.</p> <p>Brakes & Braking system:</p> <p>Purpose, principles, layout of braking system. Classification, mechanical, hydraulic, master cylinder, Tandem master cylinder, wheel cylinder, self energizing&self adjusting brakes, disc brakes, antiskid brakes, power operated brakes.</p> <p>UNIT – V</p> <p>Steering system:</p> <p>Gear & links, types of steering gears, reversibility of steering, center point steering, steering geometry viz. castor, camber, king pin inclination toe in, toe out, cornering power, under-oversteer; power steering, effect of shimmy, condition of true rolling, calculation of turning radius. Correct steering equation and related problems.</p> <p>Electrical System:</p> <p>Battery: construction, maintenance, testing and charging. Cut-out, lighting circuit, horn, signals etc.</p>
Course outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none">• Graduates will gain a strong foundation in core automobile engineering, both



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	<p>in theoretical and applied concepts.</p> <ul style="list-style-type: none">• Acquire knowledge and hands-on competence in the design and development of automobile.• Graduates will demonstrate the ability to identify and solve automobile engineering maintenance problems.
Text Books	<ol style="list-style-type: none">1. Automobile Engineering – Kripal Singh – Standard Publications, New Delhi2. Automobile Mechanics - N. K. Giri – Khanna Publishers, New Delhi
Reference Books	<ol style="list-style-type: none">1. Automobile Engineering – G.B.S. Narang – Khanna Publishers, New Delhi2. Automotive Mechanics: Principles and Practices- W.H.Crouse, and D.L. Anglin, TMH3. Automobile Engineering – K. R. Govindan – Anuradha Agencies4. The Automobile-Harbans, Reyat Singh- S.Chand , New Delhi5. Automotive Mechanics – Joseph Heitner-CBS Pub., New Delhi6. Motor Vehicle – Newton & Steeds – Life & Sons Limited.



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Course Title	REFRIGERATION & AIR-CONDITIONING				
Course Code	BENME702T				
Course Credits	L	T	P	TC	
	4	1	-	4	
Prerequisites	Understanding of basic concept of various operating cycles, thermodynamic processes.				
Course Objectives	This course will enable students to: <ul style="list-style-type: none">• Analyze vapour compression cycles• Analyze alternative systems such as gas cycle refrigeration and vapour absorption etc.• Understand psychrometry and psychrometric processes• Select/ design equipment for refrigeration and air-conditioning systems.• Carry out air conditioning calculations				
Course Contents	UNIT – I Introduction: Refrigeration and second law of Thermodynamics, Refrigeration effect and unit of Refrigeration, Heat pump, reversed Carnot cycle. Vapour Compression Refrigeration System, Analysis of simple vapour compression Refrigeration cycle by p-h and T-S diagram. Effect of operating conditions, liquid vapour heat exchangers, actual refrigeration cycle. Introduction to Multiple Evaporator and compound compression systems. UNIT – II Gas cycle Refrigeration: Limitation of Carnot cycle with gas, reversed Brayton cycle, Brayton cycle with regenerative H.E. Air cycle for aircraft. Necessity of cooling of aircraft, Basic cycle, boot strap, regenerative type aircraft refrigeration cycle. UNIT – III				



	<p>Vapour Absorption System:</p> <p>Simple vapour absorption system, Electrolux Refrigerator, Analysis of Ammonia absorption refrigeration system, Lithium Bromide Absorption Refrigeration System.</p> <p>Refrigerants:</p> <p>Classification, Nomenclature, selection of Refrigerants, global warming potential of CFC Refrigerants.</p> <p>Refrigeration Equipments: Compressor, condenser, evaporator, expansion devices – types & working.</p> <p>UNIT – IV</p> <p>Psychrometry:</p> <p>Psychrometric properties, psychometric relations, psychrometric charts, psychrometric processes, cooling coils, By-pass factor and air washers. Human Comfort Mechanism of body heat losses, factors affecting human comfort, effective temperature, comfort chart.</p> <p>UNIT – V</p> <p>Cooling load calculations:</p> <p>Internal heat gain, system heat gain, RSHF, ERSHF, GSHF, cooling load estimation, heating load estimation, psychrometric calculation for cooling, selection of air conditioning, apparatus for cooling and dehumidification,</p> <p>Air conditioning system: Central, split and window air conditioning system.</p>
<p>Course outcomes</p>	<p>After the completion of course:</p> <ul style="list-style-type: none">• Apply knowledge of Refrigeration and Air-Conditioning for understanding, formulating and solving engineering problems.• Acquire knowledge and hands-on competence in applying the concepts in analysis and design of refrigeration and air-conditioning systems.• Demonstrate creativeness in designing new systems, components and processes in the field of engineering in general and mechanical engineering in particular.• Identify, analyse, and solve mechanical engineering problems useful to the society.• Work effectively with engineering and science teams as well as with multidisciplinary designs.



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Text Books	3. Refrigeration and Air Conditioning –C. P. Arora – TMH,Delhi 4. Refrigeration and Air Conditioning – Manohar Prasad – New Age - Delhi
Reference Books	7. Refrigeration and Air Conditioning – Arora &Domkundwar – Dhanpat Rai, Delhi 8. Refrigeration & Air Conditioning-R.K.Rajput-S.K. Kataria, Delhi 9. Refrigeration and Air Conditioning – P.L. Ballaney – Khanna Pub.,Delhi 10.Refrigeration & Air Conditioning – Ahmadul Ameen - PHI, Delhi 11.Refrigeration and Air Conditioning- Stocker & Jones, McGraw Hill, Delhi 12.Basic Refrigeration and Air-Conditioning- P.N.Ananthanarayanan, TMH, Delhi 13.Principles of Refrigeration-Roy J.Dossat , -Pearson,Delhi 14.Refrigeration and Air Conditioning –R.C.Arora -PHI, Delhi



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Course Title	COMPUTER AIDED DESIGN & MANUFACTURING				
Course Code	BENME703T				
Course Credits	L	T	P	TC	
	4	1	-	4	
Prerequisites	Understanding of basic concept Engineering Drawing and Machine Drawing, comport Graphics programme.				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none">• To introduce the student to be familiar with CAD/CAM terminology & its capabilities.• To become familiar with CAD/CAM software, Graphical user interface & basic tools.• To recognize geometric and graphical elements of engineering design problems• To apply a “hands-on” understanding of the basic concepts of computer-aided manufacturing and prototyping through group and individual projects• To study Basic features of CAM so as to be capable of accepting professional responsibilities and to understand the associativity between design and manufacturing.• Integrate the CAD system and the CAM system by using the CAD system for modeling design information and converting the CAD model into a CAM model for modeling the manufacturing information.				
Course Contents	<p>UNIT-I</p> <p>Introduction:</p> <p>Introduction of CAD/CAM, Definition of CAD & CAM tools, the influence of computers on manufacturing environment, Benefits of CAD/CAM. The product cycle, product engineering, concurrent engineering.</p> <p>Window and View port:</p> <p>Window definitions, View port definitions, Window and View port relationship; World co-ordinates; Normalized device co-ordinates and Homogenous co-</p>				



ordinates.

UNIT – II

Geometric Modeling:

Requirement of Geometric Modeling, Geometric models, Geometric construction Methods, other modeling methods, 2D & 3D Transformations, Perspective and Parallel Projection, Viewing transformation.

Geometric Modeling of Curves:

Parametric and Non parametric, Explicit and Implicit, Representation of curves. Analytical Curve: Line, Circle,

Conics. Synthetic curve:

Hermite Cubic Splines, Bezier Curves, B-Spline Curves. C0, C1 & C2 Continuity, Convex hull.

UNIT –III

Representation of Surface:

Parametric Representation of surfaces, Equation of surface, Tangent vector, Normal vector, Twist vector, parametric patches and surfaces, Analytical surfaces: Ruled surface, surface of revolution, Tabulated cylinder. Synthetic surface: Hermit bi-cubic surface, Bezier bi-cubic surface, B spline bicubic surface, Coon's surface.

Solid Modeling:

Solid modeling techniques, Geometric and Topology, Valid solid, Types of solid modeling, Algorithms, Basic set theory, Solid Representation Schemes. CSG representation, 3D base primitives, Unary Operation, Boolean Operation, Sweeping Operation and CSG tree.

UNIT – IV

Numerical Control:

Introduction to Numerical Control, Basic components of an NC system, the NC procedure, NC coordinate systems, NC motion control systems, applications of Numerical Control, Introduction to Computer Control in NC, problems with conventional NC, Computer Numerical Control, Direct Numerical Control, Combined DNC/CNC system, Adaptive control machining system, NC Part Programming Introduction to NC Part Programming, Manual part programming, Computer assisted part programming, the APT (Automatically Programming Tool) language, MACRO statement in APT, Advantages of



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	<p>CAD/CAM in NC programming.</p> <p>UNIT –V</p> <p>Group Technology:</p> <p>Introduction to group technology, part families, parts classification & coding, three parts classification & coding system, group technology machinecells, benefits and Limitation of group technologyComputer integrated manufacturing (CIM) systemIntroduction of CAPP, Flexible Manufacturing System, Benefits.</p>
Course outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none">• Understand the various CAD/CAM and CNC processes.• Generate and verify the tool path and NC programs for milling and drilling manufacturing processes.• Recognize various types of Curves, surface and Solid and their application as used in geometric modeling.• Appreciate the concept of parametric modeling which is the mainstay of most of the 3D modeling system.• Write and prove sample part programs for CNC machining centres in planar milling operations using the word address format.• Understand the needs of master production schedule and methods to develop it.• Plan and execute the production activity control, which actually deals with operations in the shop floor.• Skillfully use modern engineering tools and techniques for mechanical engineering design, analysis and application.
Text Books	<ol style="list-style-type: none">1. CAD/CAM Theory and Practice- Zeid, Ibrahim & Sivasubramanian, TMH, Delhi2. CAM/CAD principle & Applications-P.N.Rao- TMH, New Delhi
Reference Books	<ol style="list-style-type: none">1. CAD/CAM-Milkell P. Groover, Emory W. Zimmer-Pearson Education, Delhi2. Computer Aided Design & Manufacturing – Lalitnarayan – PHI, Delhi3. Introduction to Computer Graphics- N. Krishnamoorthy, TMH, Delhi4. Computer Numeric Control-T.Jeyapoovan, Robert Quesada-Pearson Education5. CAD/CAM – Surendra Kumar & A.K. Jha – Dhanpat Rai , New Delhi



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Course Title	MACHINE TOOLTECHNOLOGY				
Course Code	BENME704T				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Understanding of basic concept Machine Design, Workshop Technology and Kinematics of Machine.				
Course Objectives	This course will enable students to: <ul style="list-style-type: none">• To impart knowledge about cutting tool geometry, tool material, mechanics of metal cutting, machinability and importance of cutting fluid.• To understand the kinematics drive of machine tool.• To design speed gear box and feed gear box• To understand the procedure of acceptance test of machine tool				
Course Contents	UNIT-I Cutting Tool – Types, requirements, specification & application Geometry of Single Point Cutting Tool: Tool angle, Tool angle specification system, ASA, ORS and NRS and inter-relationship. Mechanics of Metal Cutting Theories of metal cutting, chip formation, types of chips, chip breakers, Orthogonal and Oblique cutting, stress and strain in the chip, velocityrelations, power and energy requirement in metal cutting. UNIT – II Machinability: Concept and evaluation of Machinability, Mechanism of Tool failure, Tool wear mechanism, Tool life, Tool life equation,Machinability index, factors affecting machinability. Thermal Aspects in Machining and Cutting Fluid:				



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	<p>Source of heat in metal cutting and its distributions, temp measurement in metal cutting, function of cutting fluid, types of cutting fluid.</p> <p>UNIT –III</p> <p>Design of Machine Tool Elements:</p> <p>Design of Lathe bed - Material and construction feature, various bed section, analysis of force underheadstock, tail stock and saddle, torque analysis of lathe bed, bending of lathe bed, designing for torsional rigidity, use of reinforcing stiffener inlathebed.Design of Guide ways, Material and construction features, overturning diagram, Antifriction guide ways.</p> <p>UNIT – IV</p> <p>Design of Speed Gear Box:Drives in Machine Tool, classification, selecting maximum and minimum cutting speeds, speed loss, kinematicadvantage of Geometric progression, kinematic diagrams, design of Gear Box of 6,9,12 and 18 speeds.</p> <p>UNIT –V</p> <p>Design of Feed Gear Box:</p> <p>Elements of feed gear box, classification-Norton drive, draw key drive, Meander’s drive, Design of feed gear box forlongitudinal and cross feed and for thread cutting.</p> <p>Acceptance Test of Machine tool:</p> <p>Testing, Geometrical checks, measuring equipment for testing, acceptance test for Lathe and Radial drillingmachines.</p>
Course outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none">• Graduates will gain a strong foundation in machine tool engineering• Acquire knowledge and hands-on competence in design and development of machine tool.• Develop an ability to identify, analyze and solve technical problems related to machine tools.
Text Books	<ol style="list-style-type: none">1. Machine Tool Engineering – G.R. Nagpal – Khanna Publishers, New Delhi2. Fundamentals of Metal Cutting & Machine Tool – B.L. Juneja, G.S. Sekhan, Nitin Sethi – New Age Publishers – New Delhi
Reference Books	<ol style="list-style-type: none">1. Production Engineering – P. C. Sharma – S. Chand & Company – New Delhi2. Production Technology – R.K. Jain – Khanna Publisher – New Delhi



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	<ol style="list-style-type: none">3. Principle of Metal Cutting -Sen, Bhattacharya – New Central Book Agency, Calcutta4. Machine Tool Practices – Kibbe Richard R – PHI, New Delhi5. Manufacturing Technology Vol.-II – P. N. Rao - TMH Delhi6. Manufacturing Engineering & Technolgy – SeropeKalpakjian- Pearson, Delhi
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Course Title	AUTOMOBILE ENGINEERING-LAB				
Course Code	BENME701P				
Course Credits	L	T	P	TC	
	-	-	4	2	
Course Objectives	This course will enable students to: <ul style="list-style-type: none">• The students will learn about various types of chassis and clutches.• The main objective of this lab is to develop an idea of automotive system.• Understanding of various suspension system.				
Course Contents	STUDIES TO BE CARRIED OUT (MINIMUM TEN EXPERIMENTS) <ol style="list-style-type: none">1. Study of frame and chassis.2. Study of clutches – single plate, multi plate and centrifugal3. Study of gear boxes – sliding mesh, constant mesh, synchro-mesh.4. Study of differential, universal joints, axles and slip joints.5. Study of brakes – mechanical, hydraulic, air brake and disc brake.6. Study of steering system used with rigid axle suspension and independent suspension system, power steering7. Study of different types of springs used in automobiles.8. Study of rigid axle suspension system.9. Study of front independent suspension system.10. Study of independent suspension system.11. Study of battery, starting and generating system and battery charging system.12. Study of automotive electrical system.13. Study of educational car model.				
Equipments/ Machines Required	LIST OF EQUIPMENTS/MACHINES REQUIRED <ol style="list-style-type: none">1. Working model of single plate, multi-plate & centrifugal clutch2. Working model of actual differential system3. Working model of universal joint, axles & slip joints				



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	<ol style="list-style-type: none">4. Working model of mechanical, hydraulic and air brake5. Working model of steering system used with rigid axle suspension system6. Working model of steering system used with independent suspension system7. Different types of springs used in automobiles8. Working model of rigid axle suspension system9. Working model of front independent suspension system10. Working model of rear independent suspension system11. Working model of battery, starting and generating system along with charging unit12. Working model of electrical system13. Cut section of actual master cylinder of hydraulic brake system14. Educational car model
Course outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none">• Demonstration of types and working of clutch and transmission system.• Demonstrate the working of different types of final drives, steering gears and braking systems.• Illustrate the constructional features of wheels, tyres and suspension systems• Demonstrate the understanding of types of storage, charging and starting systems• Identify the type of body and chassis of an automobile• Comprehend the different technological advances in automobile



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Course Title	REFRIGERATION & AIR-CONDITIONING- LAB				
Course Code	BENME702P				
Course Credits	L	T	P	TC	
	-	-	4	2	
Course Objectives	This course will enable students to: <ul style="list-style-type: none">• Understand the basic structure of an automobile• Understand construction of suspension system• Understand transmission system and its elements• Understand braking system, steering system and electrical system				
Course Contents	EXPERIMENTS TO BE PERFORMED (MINIMUM SEVEN NUMBERS) <ol style="list-style-type: none">1. To study Domestic Refrigerator.2. To study the Hermetically Sealed Compressor.3. To study Refrigeration Tutor and to determine the following:-<ol style="list-style-type: none">a. Theoretical coefficient of Performanceb. Actual Coefficient of Performance.c. Theoretical capacity of the plantd. Actual capacity of the plant.4. To Study the Mechanical Heat Pump and to determine the following:-<ol style="list-style-type: none">a. Theoretical coefficient of Performanceb. Actual Coefficient of Performance.c. Theoretical capacity of the plantd. Actual capacity of the plant5. To study the Air and Water Heat Pump and to determine the following:-<ol style="list-style-type: none">a. Theoretical coefficient of Performance of the system as a refrigerator and as a heat pump.b. Actual Coefficient of Performance of the system as a refrigerator and as a heat pump.				



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	<ul style="list-style-type: none">c. Capacity of the system in tons as a refrigerator.d. Capacity of the system in kW as a heat pump under the following conditions of operation:-<ul style="list-style-type: none">i. Water cooled condenser and water-cooled evaporator.ii. Water-cooled condenser and air-cooled evaporator.iii. Air-cooled condenser and air-cooled evaporator.iv. Air-cooled condenser and water-cooled evaporator.6. To study the following processes on the Air Conditioning Test Rig.<ul style="list-style-type: none">a. Sensible Heatingb. Sensible Coolingc. Sensible Cooling/cooling dehumidificationd. Humidification and cooling7. To Find the Efficiency of Cooling Tower Test Rig.8. To Study the Simple Vapor Absorption System.9. To study the AC Simulator and to determine the following:-<ul style="list-style-type: none">a. Sensible Heatingb. Sensible Coolingc. COP of R-22d. Air Washer Efficiencye. Sensible heat load appliedf. Latent heat load appliedg. RSHFh. ESHFi. Creation of different climatic conditions in AC simulator
Equipments/ Machines Required	LIST OF EQUIPMENTS/MACHINES REQUIRED <ul style="list-style-type: none">1. Domestic Refrigerator2. Cut Section of Hermitically Sealed Compressor3. Refrigeration Tutor Test Rig



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	<ol style="list-style-type: none">4. Mechanical Heat Pump Test Rig5. Air & Water Heat Pump Test Rig6. Air Conditioning Test Rig7. Simple Absorption System Test Rig8. Cooling Tower Test Rig9. Air Conditioning Simulator Test Rig
Course outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none">• Demonstrate fundamental principles of refrigeration and air conditioning• Identify and locate various important components of the domestic refrigerationsystem• Illustrate various refrigeration and air conditioning processes.• Design Air Conditioning system using cooling load calculations.• Estimate air conditioning system parameters.• Demonstrate understanding of duct designconcepts



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Course Title	COMPUTER AIDED DESIGN & MANUFACTURING LAB				
Course Code	BENME703P				
Course Credits	L	T	P	TC	
	-	-	4	2	
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none">• Understand the basic of computer program.• Understand various geometric algorithms.• Understanding and use of any 3-D Modeling Software commands				
Course Contents	<p>Total TEN Experiments are to be carried out. FIVE Experiments each from CAD and CAM.</p> <p>A. CAD Experiments</p> <ol style="list-style-type: none">1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.2. Geometric Transformation algorithm experiment for translation/rotation/scaling: Writing and validation of computer program.3. Design of machine component or other system experiment: Writing and validation of computer program.4. Understanding and use of any 3-D Modeling Software commands.5. Experiment: Solid modeling of a machine component using Advanced-modeling software.6. Root findings or curve fitting experiment: Writing and validation of computer program.7. Numerical differentiation or numerical integration experiment: Writing and validation of computer program. <p>B. CAM Experiments</p> <ol style="list-style-type: none">1. To study the characteristic features of CNC machine2. Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC				



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	<p>machine</p> <p>3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine</p> <p>4. Part Programming (in word address format or ATP) experiment for milling operation(contouring) and running on CNC machine</p>
Course outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none">• Identify proper computer graphics techniques for geometric modeling.• Transform, manipulate objects & store and manage data.• CAM Tool path Creation and NC- G code output.• Use rapid prototyping and tooling concepts in any real life applications.• Identify the tools for Analysis of a complexengineering component
Equipments/ Machines Required	<p>Autocad software and CAM software</p>



Professional Elective-II

Course Title	QUALITY CONTROL & TOTAL QUALITY MANAGEMENT				
Course Code	BENME705A				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Understanding of basic concept statistical mathematics, about ISO, industrial management, and process of management.				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none">• Define and understand various terms associated with quality control• Enhance the students understanding of the complexity of statistical analysis and interpretation.• Provide an introduction to the fundamental concept of SPC, total quality management, six sigma, quality function deployment and applications of these concepts.• Understanding the philosophies of TQM in order to better evaluate the TQM implementation proposals.• Assess exactly where an organization stands on quality management with respect to ISO 9000 quality management.				
Course Contents	<p>UNIT-I</p> <p>Basic Concept of Quality</p> <p>Quality and quality control, concept of quality, quality characteristics, Quality of design and quality of conformance ,History of quality control,Quality policy and objectives, Economics of quality.</p> <p>Statistical Concept of Variation</p> <p>Concept of variation frequency distribution, continuous and discrete, probability distributions viz. Normal, Exponential and Weibull distribution,pattern of variation, significance tests, Analysis of variance, statistical aids in limits and tolerances.</p> <p>UNIT-II</p>				



	<p>Quality Assurance</p> <p>Concept, advantages, field complaints, quality rating, quality audit, inspection planning, quality mindness, quality budget, vendor quality rating(VQR), vendor rating (VR), manufacturing planning for quality, Quality function deployment (QFD).</p> <p>Statistical Quality Control</p> <p>Objectives, Growth and applications of S.Q.C., S.O.C, Techniques in manufacturing planning. Process capability analysis, Control charts for variables and attributes and their analysis, process capability, concept of six sigma.</p> <p>UNIT III</p> <p>ACCEPTANCE SAMPLING</p> <p>Fundamental concept in acceptance sampling, operating characteristics curve. Acceptance plans, single, double and introduction of multiple plans.</p> <p>UNIT -IV</p> <p>Total Quality Management</p> <p>Total Quality Control (TQC), Concept of Total Quality Management (TQM), TQM philosophies, Deming approach to TQM, Juran ten steps to Quality Management, Taguchi Philosophy, Crosby fourteen steps, TQM models, Tools and techniques of TQM,</p> <p>UNIT V Quality system</p> <p>Quality system, need for quality system, ISO 9000 Quality Management Standards, ISO 9000:2000 requirement, Quality Auditing, ISO 14000, Benefits of ISO 14000.</p>
<p>Course outcomes</p>	<p>After the completion of course:</p> <ul style="list-style-type: none">• Explain the importance of quality & role of statistical quality control• Apply methods and techniques of statistical quality control, to studies and interpret the results in business.• Demonstrate motivation and responsibility to advocate for quality in business• Develop an understanding on quality management philosophies and frameworks• Develop in-depth knowledge on various tools and techniques of quality management



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Text Books	<ol style="list-style-type: none">1. Quality Planning and Analysis - Juran&Gryana – McGraw Hill, New York2. Statistical Quality Control – R.C. Gupta – Khanna Publishers, Delhi
Reference Books	<ol style="list-style-type: none">1. Statistical quality control – Grant and Leavenworth – McGraw Hill, New York2. Engineering Statistics and Quality Control – I. W. Burr- McGraw Hill, New York3. Managing for Total Quality - Logothetis – PHI Delhi4. Statistical Quality Control – M. Mahajan – Dhanpat Rai – New Delhi5. Total Quality Management – Suganthi& Samuel - PHI, Delhi6. Total Quality Management - Charantimath, Poornima – Pearson, Delhi7. Total Quality Management – K.C. Arora - S.K. Kataria- New Delhi



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
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Course Title	PRODUCT DESIGN & DEVELOPMENT				
Course Code	BENME705B				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Understanding of basic concept of product design and implement different concepts involved in method study and understanding of work content in different situations.				
Course Objectives	This course will enable students to: <ul style="list-style-type: none">• To introduce design concepts and techniques to develop design ability in a product design.• To provide knowledge about estimating and evaluating the feasible manufacturing design.• To make aware of legal issue pertaining to product design.• To provide knowledge of management of product development projects				
Course Contents	UNIT-I Product Development Process Background for design, design theory, design materials, human factors in design applied ergonomics, product development processes and organization, identifying customer needs, establishing product specifications, concept generation and selecting product architecture. UNIT-II Product Design Methods Generating concepts, selection of a concept, Testing of concept, product architecture, Creative and rational clarifying objectives- the objective trees methods, establishing functions – the function analysis methods, setting requirement- requirements specification methods determining characteristics – the QFD method, generating alternatives-the morphological chart method, evaluating alternatives-the weighted objectives methods, improving details-the value engineering method and design strategies. UNIT –III				



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	<p>Design for Manufacture</p> <p>Estimating manufacturing costs, reducing component, assembly and support cost design for assembly, design for disassembly, design for environment, design for graphics and packaging, effective prototyping – principle and planning.</p> <p>UNIT –IV</p> <p>Industrial Design</p> <p>Its need - Ergonomic needs, Aesthetic needs, impact, accessing the quality, steps involved in Industrial design process, Management of Technology & user driven products.</p> <p>UNIT – V</p> <p>Patents, Product Development & Project Management</p> <p>Legal issues in product design, trademarks, trade-secret, copy rights, patents – types, steps for disclosure, design resources, economics – quantitative & qualitative analysis, management of product development projects, Design Structure Matrix, Gantt Chart, Project schedule, budget, risk plan, accelerating project, execution, assessing and correction, Intellectual property rights.</p>
Course outcomes	<p>After the completion of course:</p> <ol style="list-style-type: none">1. The course enhance students understanding of new product development processes as well as useful tools, techniques and organizational structures that support new product development practice.2. Understands the legal issue pertaining to patent of product design.3. Understand professional, ethical and social responsibilities resulting in a commitment to quality, timeliness, and continuous improvement.
Text Books	<ol style="list-style-type: none">1. Product Design & Development - Karl. T. Ulrich and Steven D. Eppinger – TMH, Delhi.2. Product Design – Kevin Otto and Kristin wood - Pearson Education.
Reference Books	<ol style="list-style-type: none">1. Product Development - Chitale & Gupta - Tata McGraw Hill.2. Product Design and Manufacturing – Chitale & Gupta – PHI, Delhi.3. Product Design: Creativity, Concepts and Usability – Kumar – PHI, Delhi .4. Concurrent Engineering in Product Design and Development- Imad Moustapha – New Age.5. Operations Management- Monks, J.G - McGraw Hill.6. Product Design and Development - Ulrich & Eppinger – TMH Delhi.



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
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Course Title	THERMAL SYSTEM DESIGN				
Course Code	BENME705C				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Understanding of basic concept of Applied thermodynamic, optimization techniques and various foods preservation techniques.				
Course Objectives	This course will enable students to: <ul style="list-style-type: none">• To enable the students to understand the concepts of thermal system design• To provide knowledge about economics of thermal system• Be familiar with modeling, simulation optimization techniques of thermal systems				
Course Contents	UNIT-I Introduction to Thermal System Design Thermal system design, concept and major applications, categories of thermalsystem design. Designing A Workable Thermal System Introduction, Workable vs. Optimum system, various design basis, design of afood freezing plant and several other examples. UNIT–II Economics of Thermal Systems Introduction, Major and minor costs, Interest, present and future worth, economicevaluation of thermal system design, Life cycle costing (LCC)method of economic evaluation, Effect of inflation, Presentworth of yearly installment taking inflation into account, Preliminary cost estimation, equipment cost estimating parameter,effect of time factor on costs, energy costs, Taxes, Depreciation. UNIT– III Modeling of Thermal Systems				



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	<p>Introduction, curve fitting or equation fitting for one, two and polynomial independent variable, Example of curve fitting for thermal systems, Best fit equation, least square method with example, Some example of mathematical modeling of thermal systems.</p> <p>UNIT-IV</p> <p>Thermal System Simulation</p> <p>Introduction, classes of systems, information flow diagrams, Sequential and simultaneous calculations, Formulation of information flow diagram of thermal systems some example like water pumping systems, waste heat utilization systems.</p> <p>Methods of Simultaneous Calculations</p> <p>Successive substitution method and Newton-Raphson method, Newton-Raphson method for multiple functions, Simulation of Gas turbine system.</p> <p>UNIT – V</p> <p>Optimization of Thermal Systems</p> <p>Introduction, Mathematical representation of optimization problem with example of water chilling system, Lagrange multipliers, Heat exchanger optimization with Lagrange multipliers</p>
Course outcomes	<p>After the completion of course:</p> <ol style="list-style-type: none">1. Demonstrate a basic understanding of concepts of thermal system design.2. Acquire knowledge and hands-on competence in the design and development of thermal systems that meet specific energy demands, are economically feasible and have a minimal impact on the environment.
Text Books	<ol style="list-style-type: none">1. Design of Thermal Systems - Stoecker W.F. - McGraw Hill2. Advanced Thermodynamic for Engineers - Wark K. - John Wiley
Reference Books	<ol style="list-style-type: none">1. Advanced Engineering Thermodynamics - Bejan A. - John Wiley2. Advanced Engineering Thermodynamics - Annamalai K. & Puri - CRC Press3. Thermal Design & Optimization - Bejan A., Tsatsarones G. & Moran M - John Wiley4. Fundamentals of Engineering Thermodynamics - Moran M.J. & Shapiro H.N - John Wiley