



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Shri Rawatpura Sarkar University, Raipur



Examination Scheme & Syllabus

for

B.Tech in Mechanical Engineering

Semester-V

(Effective from the session: 2022-23)



**SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING**

**Four Years B.Tech. Programme
Scheme of Teaching and Examination
B.Tech. Fifth 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.	BENME501T	Machine Design – I	3	1	-	4	30	70	100	3
2.	BENME501P	Machine Design-I Lab	-	-	4	2	15	35	50	-
3.	BENME502T	Turbo Machinery	3	1	-	4	30	70	100	3
4.	BENME503T	Dynamics of Machines	3	1	-	4	30	70	100	3
5.	BENME503P	Dynamics of machines-Lab	-	-	4	2	15	35	50	-
6.	BENME504T	Fluid Machinery	3	1	-	4	30	70	100	3
7.	BENME504P	Fluid Machinery -Lab	-	-	4	2	15	35	50	-
8.	BENME505T	Manufacturing Science - II	3	1	-	4	30	70	100	3
9.	BENME505P	Manufacturing Science -Lab	-	-	4	2	15	35	50	-
10	BENME506T	Operations Research	3	1	-	4	30	70	100	3
						32			800	



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Course Title	MACHINE DESIGN – I				
Course Code	BENME501T				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Understanding of basic concept of Engineering Mechanics, Strength of material, Numerical analysis, physics, proper selection and use of various properties of materials.				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> • To choose proper materials to different machine elements depending on their physical and mechanical properties. • To design and analyze basic elements of machine e.g. key, shaft and axle. • To design and analyze various type of joints for members with axial load • To design and analyze couplings and clutches for members in torsion • To design and analyze threaded fastener and power screws • To design and analyze riveted and welded joint 				
Course Contents	<p>UNIT – I</p> <p>General Considerations:</p> <p>Selection of Materials, Design Stress, Factor of Safety, Stress concentration factor intension, bending and torsion, theories of failures. Notch sensitivity, design stress for variable and repeatedloads, fatigue stress concentration factor, endurance diagrams.</p> <p>UNIT - II</p> <p>Basic Elements Design: Design of socket-spigot cotter joint, sleeve and cotter joint, design of Knuckle joint.</p> <p>Keys and Couplings: Types of keys, design of keys, design of splines.Types of couplings, design of flange and flexible couplings, compression coupling, muff coupling.</p> <p>UNIT - III</p>				



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

	<p>Shafts and Axles: Transmission shaft, Design against static load, Design for strength, rigidity and stiffness, design under continuous loading for fatigue.</p> <p>Clutches: Friction clutches, Friction materials, Torque transmitting capacity, Single & Multiple plate clutch, Centrifugal clutches.</p> <p>UNIT - IV</p> <p>Threaded fasteners: Geometry of thread forms, terminology of screw threads and thread standards, specifications of steel bolts, initial tension, and relation between bolt tension and torque, design of statically loaded tension joints, design of bolted joints due to eccentric loading.</p> <p>Power Screws: Power screws, Force analysis-square and trapezoidal threads, Collar friction, Stresses in screw, coefficient of friction, efficiency of thread.</p> <p>UNIT - V</p> <p>Riveted Joints: Types of rivet heads, types of riveted joints, failure of riveted joint, strength of rivet joint, efficiency of riveted joint, design of riveted joint for boiler.</p> <p>Welded joints: Types of welded joints, stresses in butt and fillet welds, strength of welded joints, location and dimension of weld design, eccentrically loaded joint, welded joint subjected to bending moment, design procedure, fillet welds under varying loads, stress relieving techniques.</p>
Course outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none"> • Apply knowledge of machine design for understanding, formulating and solving engineering problems. • Acquire knowledge and hands-on competence in applying the concepts in the design and development of mechanical systems. • Demonstrate creativeness in designing new systems components and processes in the field of engineering in general and mechanical engineering in particular. • Identify, analyze, and solve mechanical engineering problems useful to the society. • Work effectively with engineering and science teams as well as with multidisciplinary designs.
Text Books	<ol style="list-style-type: none"> 1. Design of Machine Elements- V.B.Bhandari - TMH, New Delhi 2. Mechanical Engineering Design - Shigley – McGraw Hill, Delhi
Reference Books	<ol style="list-style-type: none"> 1. Machine Design - Movnin – MIR Publishers, Moscow



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

- | | |
|--|--|
| | <ol style="list-style-type: none">2. Machine Design - Fundamental & Application – Gope –PHI, New Delhi3. Machine Design - Sharma &Agrawal – Katson, New Delhi4. Principles of Mechanical Design - R. Phelan – McGraw Hill, New Delhi.5. Machine Design – Sundarajamoorthy&Shanmugum– Anuradha Agencies, Chennai |
|--|--|



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Course Title	TURBO MACHINERY				
Course Code	BENME502T				
Course Credits	L	T	P	TC	
	4	1	-	4	
Prerequisites	Understanding of basic concept of Engineering and Applied Thermodynamic.				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> • To study classifications of turbo-machines. • To study construction and working of different turbo- machines • To acquire the knowledge and skill of analyzing different turbo- machines 				
Course Contents	<p>UNIT – I</p> <p>Impulse Turbine: Steam turbine:</p> <p>Principal of operation of steam turbine, types of impulse turbine,compounding of steam turbine-pressure compounded, velocity compounded and pressure velocity compounded impulse turbine. Velocity diagram for impulse turbine, force on the blade and work done. Blade or diagraefficiency, axial thrust, gross stage efficiency. Influence of ratio of blade velocity to steam velocity on bladeefficiency in a single stage impulse turbine. Efficiency of multi-stage turbine. Impulse blade sections, choice ofblade angle. Blade height in velocity compounded impulse turbine.</p> <p>UNIT - II</p> <p>Impulse Reaction Turbine:</p> <p>Velocity diagram, degree of reaction, impulse-reaction turbine with similar blade section and half degree of reaction. (Parson’s turbine) Height of reaction turbine blading ,Losses in steamturbine ,Internal losses-throttling losses, ,Nozzle friction losses, blade friction losses, disc friction losses, bladewindage losses or partial admission losses, leakage or clearance losses, loss due to wetness of steam,carry-overloss. , residual loss, radiation loss, external losses-Mechanical friction and bearing losses.</p>				



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

	<p>UNIT - III</p> <p>State Point Locus and Reheat Factor:</p> <p>Stage efficiency of impulse turbines, stage point locus of an impulse turbine, state point locus for multistage turbine, reheat factor. Internal efficiency, overall efficiency, relative efficiency, Governing of steam turbine. Throttle governing, nozzle governing, bypass governing, combination of throttle and nozzle, governing and combination of bypass and throttle governing. Effect of governing on the performance of steam turbine.</p> <p>UNIT - IV</p> <p>Gas Turbine:</p> <p>Classification of gas turbine. Applications, Simple open cycle gas turbine, Ideal and actual cycle for gas turbine, polytropic or small stage efficiency, cycle air rate, cycle work ratio, Optimum pressure ratio for maximum specific output in actual gas turbine, optimum pressure ratio for maximum cycle thermal efficiency, means of improving the efficiency and specific output. Open cycle gas turbine with regeneration, reheat and inter cooling and effect of these modification on efficiency and output. Closed cycle gas turbine.</p> <p>UNIT - V</p> <p>Turbo Compressors:</p> <p>Introduction, classifications of Centrifugal compressors – components, working, velocity diagrams, calculations of power and efficiencies. Slip factor, surging and choking, power and efficiencies.</p> <p>Axial Flow Compressor:</p> <p>Construction and working, velocity diagram, calculation of power and efficiencies. Degree of reaction, work done factor, stalling, comparison of centrifugal and axial flow compressor.</p>
<p>Course outcomes</p>	<p>After the completion of course:</p> <ul style="list-style-type: none">• Apply knowledge of turbo machinery for understanding, formulating and solving engineering problems.• Acquire knowledge and hands-on competence in the design and development of mechanical systems.• Identify, analysis, and solve mechanical engineering problems useful to the society.• Work effectively with engineering and science teams as well as with multidisciplinary designs.



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Text Books	<ol style="list-style-type: none">1. Steam and Gas Turbine and Power Plant Engineering-R. Yadav - Central Publishing House, Allahabad2. Turbine, Compressors and Fan- S.M. Yahya - TMH, Delhi
Reference Books	<ol style="list-style-type: none">1. Gas Turbine – V. Ganeshan – TMH, Delhi2. Fundamental Of Compressible Flow- S.M. Yahya - TMH, Delhi3. Gas Dynamics with Application: S.K. Kulshrestha4. Fundamentals Of Compressible Fluid Dynamics- P.Balachandran- PHI, Delhi5. Fundamental of Gas Dynamics-K.L.Yadao-Khanna Publications,Delhi



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Course Title	DYNAMICS OF MACHINES				
Course Code	BENME503T				
Course Credits	L	T	P	TC	
	4	1	-	4	
Prerequisites	Understanding of basic concept of Engineering Mechanics				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> • To study types of mechanical governors and to analyze its performance parameters. • To apply the theory of balancing to rotating and reciprocating masses. • To analyze gyro-effect on moving bodies. • To understand the concepts of mechanical vibration. • To perform inertia force analysis of machine elements. • To draw turning moment diagram of reciprocating engines. • To analyze performance parameters flywheel. 				
Course Contents	<p>UNIT – I</p> <p>Governors:</p> <p>Characteristics of centrifugal governors, Gravity controlled governors, Porter and proell. Spring controlled centrifugal governor: Hartung, & Hartnell governor. Performance parameter: Sensitivity, stability, Isochronisms, Governor Effort and power.</p> <p>UNIT - II</p> <p>Balancing:</p> <p>Balancing of rotating masses, Static and dynamic balancing, Determination of balancing masses in two plane balancing, Balancing of internal combustion engines, Balancing of in-line engines, Firing order, Balancing of V-twin and radial engines, Forward and reverse crank method, Balancing of rotors.</p> <p>UNIT - III</p>				



**SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING**

	<p>Gyroscope:</p> <p>Gyroscopic forces and couple, gyroscopic effect in Airplanes, Ship motion and Vehicles moving on curved path.</p> <p>UNIT - IV</p> <p>Mechanical Vibrations:</p> <p>One-dimensional, longitudinal, Transverse, and torsional vibrations, Natural frequency, Effect of damping on vibrations, Different types of damping. Forced vibration, Forces and displacement, Transmissibility, Vibration Isolation, Vibration sensors: seismometer and Accelerometers, Whirling of shafts with single rotor.</p> <p>UNIT - V</p> <p>Inertia force analysis:</p> <p>Effective force and inertia force on link, Inertia force on reciprocating engine. Inertia force in four bar chain mechanism.</p> <p>Turning moment diagram and flywheel:</p> <p>Turning moment diagram for single and multi cylinder internal combustion engine, Coefficient of fluctuation of speed, Coefficient of fluctuation of energy, Flywheel.</p>
Course outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none"> • Apply knowledge of Dynamics of machine for understanding, formulating and solving engineering problems. • Acquire knowledge and hands-on competence in applying the concepts Dynamics of machine in the design and development of mechanical systems. • Demonstrate creativeness in designing new systems components and processes in the field of engineering. • Identify, analyze and solve mechanical engineering problems useful to the society. • Work effectively with engineering and science teams as well as with multidisciplinary designs.
Text Books	<p>3. Theory of Machine- S.S.Rattan - Tata McGraw Hill, New Delhi</p> <p>4. Theory of Machines - Thomas Bevan, - CBS/ Cengage Publishers</p>
Reference Books	<p>6. Theory of Machines and Mechanism– Uicker, Pennock, & Shigley – Oxford Univ. Press</p>



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

- | | |
|--|--|
| | <ol style="list-style-type: none">7. Theory of Mechanisms and Machines- A. Ghosh, A. K. Mallik – EWP Press.8. Mechanism and Machine theory-Ambekar-PHI,Delhi9. Theory of Machine – P.L. Ballaney – Khanna Publishers, New Delhi10.Theory of Machine -JagdishLal- Metro Politan Books, New Delhi |
|--|--|



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Course Title	FLUID MACHINERY				
Course Code	BENME504T				
Course Credits	L	T	P	TC	
	4	1	-	4	
Prerequisites	Understanding of basic concept of calculus, linear algebra, physics and Engineering Mechanics.				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> • To understand boundary layer theory. • To formulate basic equations for impact of free jets. • To understand construction and working and performance of various Turbines. • To understand construction and working & performance of various Pumps. • To solve and analyze a variety of fluid mechanics and fluid machinery related problems. 				
Course Contents	<p>UNIT I</p> <p>Boundary Layer Theory:</p> <p>Boundary layer definition and characteristics, momentum equation, Laminar and turbulent boundary Layer, Total drag, separation and control. Flow around submerge bodies Force exerted by flowing fluid on a body: Drag and lift; stream lined and bluff body, Drag on sphere and cylinder, circulation and lift on circular cylinder, lift of an air foil, induced drag.</p> <p>UNIT II</p> <p>Impact of Free Jets:</p> <p>Impulse momentum principle, force exerted by the jet on stationary flat and curved plate, hinged plate, moving plate and moving curve vanes, jet propulsion of ship.</p> <p>Impulse Turbine:</p> <p>Classification of turbine, impulse turbine, Pelton wheel, Construction working, work done, head efficiency and Design aspects, Governing of impulse turbine.</p> <p>UNIT III</p> <p>Reaction Turbine:</p> <p>Radial flow reaction turbine, Francis turbine: construction, working, work done, efficiency, design aspect, advantages & disadvantages over Pelton wheel.</p>				



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

	<p>Axial flow reaction turbine Propeller and Kaplan turbine, bulb or tubular turbine, draft tube, specific speed, unit quantities, cavitation, degree of reaction, performance characteristics, surge tanks, governing of reaction turbine.</p> <p>UNIT IV Centrifugal Pumps: Classification of Pumps, Centrifugal pump, Construction, working, work done, heads, efficiencies, multistage centrifugal pump, pump in series and parallel, specific speed, characteristic, net positive suction head, cavitation.</p> <p>UNIT V Reciprocating Pumps: Classification, component and working, single acting and double acting pump, discharge, work-done and power required, slip & coefficient of discharge, indicator diagram, air vessels.</p>
<p>Course outcomes</p>	<p>After the completion of course:</p> <ul style="list-style-type: none"> • Apply knowledge of fluid mechanics and fluid machinery for understanding, formulating and solving engineering problems. • Acquire knowledge and hands-on competence in applying the concepts of fluid mechanics and fluid machinery in the design and development of mechanical systems. • Identify, analysis, and solve mechanical engineering problems useful to the society. • Work effectively with engineering and science teams as well as with multidisciplinary designs.
<p>Text Books</p>	<ol style="list-style-type: none"> 1. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar– Kataria& Sons –Delhi 2. Fluid Mechanics- Yunush A Cengel, John M. Cimbala- TMH, Delhi
<p>Reference Books</p>	<ol style="list-style-type: none"> 1. A text of Fluid Mechanics – R. K. Rajput – S. Chand & Company Ltd., Delhi 2. Fluid Mechanics & Hydraulics Machines-R.K.Bansal- Laxmi Publications, Delhi 3. Mechanics of Fluid – B.S. Massey – English Language Book Society (U.K.) 4. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas- TMH, Delhi 5. Hydraulics and Fluid Mechanics Including Hydraulic Machine- PN Modi, & SM Seth-Standard, Delhi 6. Hydraulic Machines: Fundamentals of Hydraulic Power Systems – P. Kumar – BSP Books Pvt, Ltd., Hyderabad



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Course Title	MANUFACTURINGSCIENCE - II				
Course Code	BENME505T				
Course Credits	L	T	P	TC	
	4	1	-	4	
Prerequisites	Understanding of basic concept of selection of various material properties, Engineering Mechanics and Thermodynamic.				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> • To understand grinding and other surface finishing operations. • To understand various non conventional machining processes and their applications. • To get knowledge of various metal forming processes. • To understand principle of sheet metal forming operations. • To understand the process of Gear Shaping and Gear Hobbing. • To understand the design considerations of Jigs and Fixtures. 				
Course Contents	<p>UNIT I</p> <p>Grinding:</p> <p>Processes. Grinding wheels, compositions- abrasives, bonding materials. Grinding wheel characteristics-abrasive type, grain size, bonding material, structure, and grade. Wheel specification and selection. Wheel life. Types of grinding operations, design consideration for grinding, specification of grinding wheel, process parameters, economics of grinding.</p> <p>Surface finishing operations:</p> <p>Honing, lapping, super finishing, polishing, buffing, process parameters and attainable grades of surface finish.</p> <p>UNIT II</p> <p>Unconventional Machining:</p> <p>Advantages, application and limitation, Processes- Electro Discharge Machining(EDM), Electro Chemical Machining (ECM), Ultrasonic Machining (USM), Abrasive Jet Machining (AJM), Electron Beam Machining (EBM), Laser Beam Machining (LBM), Electro Chemical grinding(ECG) .Mechanics of metal removal, tooling, equipment, process parameters and surface finish obtained &</p>				



specific applications.

UNIT III

Introduction to metal forming:

Classification, Hot and Cold working.

Forging:

Principle. Forging operations, drawing out and upsetting. Types of forging method-smith, drop, press and machine forging. Forging equipment. Forging dies. Tools and fixture of forging, forging dies. Forging design, Forging design factors. Drop forging die design, Upset forging die design. Forging practice – sequence of steps. Forging defects. Inspection and testing of forged parts.

Extrusion:

Principle, extrusion processes-hot extrusion, cold extrusions. Process parameters. Extrusion equipment. Extrusion of seamless tubes. Extrusion defects.

UNIT IV

Rolling :

Principle, classification of rolled products, Types of rolling mills, rolling mill train components, Roll pass sequences-break down passes, roughing passes, finishing passes. Roll pass design for continuous mill. Roll separating force. Rolling load calculation. Power required in rolling. Effect of front and back tensions. Effect of friction. Shape rolling operations-ring rolling, thread rolling. Defects in rolled products.

Drawing:

Principle, Wire drawing, tube drawing. Drawing equipments and dies. Calculation of drawing load and power requirement.

UNIT V

Sheet metal forming

Types of presses: Selection of press, components of a simple press, press working operations – shear, bending.

Shearing operations: Blanking, piercing, trimming, shaving, nibbling and notching. Calculation of punching force and shear force. Punch and die size calculation.

Drawing operation: Principle of operation. Draw die design.

Bending operation: Principle of operation. Bend allowances. Bending force.



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

	<p>Length of sheet estimation. Bendradius. Spring back effect.</p> <p>Other operation: Spinning. Stretch forming, Embossing and Coining.</p>
Course outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none">• Acquire knowledge and hands on competence in applying concept of manufacturing science in design and development of mechanical and other engineering systems.• Skillfully use modern engineering tools and techniques for mechanical engineering design, analysis and application.• Demonstrate creativeness in designing new system components and processes in the field of engineering in general and mechanical engineering in particular.• Work effectively with engineering and science teams as well as with multidisciplinary design.
Text Books	<ol style="list-style-type: none">1. Manufacturing Technology (Vol. - I & II) – P.N. Rao – Tata McGraw Hill Pub. Company, New Delhi2. A Text Book of Production Technology (Manufacturing Processes) – P.C. Sharma – S. Chand and Company Ltd., New Delhi
Reference Books	<ol style="list-style-type: none">1. Manufacturing Engineering and Technology – S. Kalpakjian & S.R. Schmid – Addison Wesley Longman, New Delhi2. Tool Engineering & Design – G.R. Nagpal – Khanna Publishers – New Delhi3. A Text Book of Production Technology – O.P. Khanna – Dhanpat Rai & Sons, New Delhi4. Manufacturing Science – A. Ghosh & A.K. Mallik – East West Press Pvt. Ltd., New Delhi5. Production Technology – R.K. Jain – Khanna Publishers, New Delhi



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Course Title	OPERATIONSRESEARCH				
Course Code	BENME506T				
Course Credits	L	T	P	TC	
	4	1	-	4	
Prerequisites	Understanding of basic concept of calculus of several variables, Numerical Analysis and Engineering Mathematics.				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> • Understand definition, scope, objectives, phases, models & limitations of operations research. • To understand different application areas of operations research like transportation problem, assignment model, sequencing models, dynamic programming, game theory, replacement models & inventory models 				
Course Contents	<p>UNIT I</p> <p>Introduction:</p> <p>Various stages of O.R., Fields of application, optimization and its classification. 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 L.P.P. in Mechanical Engineering.</p> <p>UNIT II</p> <p>The Transportation Problems:</p> <p>Mathematical formulation computational procedures, Stepping stone method, Modified Distribution Method, Vogels Approximation Method, Solution of balanced and unbalanced transportation problems and case of Degeneracy.</p> <p>The Assignment Problems:</p> <p>Mathematical formulation of assignment problems, solution of assignment problems, traveling salesman problems, Air crew Assignment problems.</p> <p>UNIT III</p> <p>Waiting Line Theory:</p> <p>Basic queuing process, basic structure of queuing models, some commonly</p>				



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

	<p>knownqueuing situations Kendall's service time, solution to M/M/1: _ /FCFS models.</p> <p>Network Analysis:</p> <p>CPM/PERT, Network Representation, Techniques for drawing network. Resourcesmoothing and leveling, project cost, Optimum project duration, project crashing, updating, Time estimationin PERT.</p> <p>UNIT IV</p> <p>Game Theory:</p> <p>Introduction, two person zero sum game, methods for solving two person zero sum game:when saddle point exists, when no saddle point exists, solution of 2xn and mx2 game.</p> <p>Simulation:</p> <p>Basic concept of simulation, applications of simulation, merits and demerits of simulation, Monte Carlo simulation, simulation of Inventory system, simulation of Queuing system.</p>
<p>Course outcomes</p>	<p>After the completion of course:</p> <ul style="list-style-type: none"> • Identify and develop operational research models from the verbal description of the real system. • Understand the mathematical tools that are needed to solve optimization problems. • Use mathematical software to solve the proposed models • Develop a report that describes the model and the solving technique, analyze the results and propose recommendations in language understandable to the decision-making processes in Management Engineering. • A student will be able use knowledge of operations research to solve transportation problems, assignment problems, sequencing problems, dynamic programming & game theory.
<p>Text Books</p>	<ol style="list-style-type: none"> 1. Operation Research , SasienYaspan 2. Operation Research – N. D. Vohra – TMH 3. Operation Research– Hira & Gupta – S. Chand & Co. 4. Engineering Optimization: Theory and Practice- S.S.Rao- New Age Publishers.
<p>Reference Books</p>	<ol style="list-style-type: none"> 1. Operation Research – H. Gillette – TMH, New Delhi 2. Operations Research – Hamdy.M. Taha – TMH, New Delhi



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

- | | |
|--|---|
| | <ol style="list-style-type: none">3. Fundamentals of Operation Research – AckofSasiene – Dhanpat Rai & Sons.4. Quantitative Approach to Management – Lovin and Krit Patrick – TMH5. Operation Research– S.D. Sharma – S. Chand & Com. New Delhi |
|--|---|



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Course Title	MACHINE DESIGN-I LAB				
Course Code	BENME501P				
Course Credits	L	T	P	TC	
	-	-	4	2	
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> • To teach students how to apply the concepts of stress analysis, theory of failure and material science to analyze, and/or select. • To illustrate to students the variety of mechanical components available and emphasize the need to continue learning. 				
Course Contents	<p>List of Experiments/Activities:</p> <ol style="list-style-type: none"> 1. Select a daily use product and design the conceptual design by applying the design process taking the controlling parameters 2. Make a list of mechanical components and know their materials and suggest some alternative materials for the each one of them. 3. Find a flange coupling in the college laboratory and justify its design by actual measurements 4. Design a shaft used in some practical application, by actual working and loading conditions 5. Justify the design of single plate clutch of an engine assembly 6. Design a wall bracket, which is being used in real life by actual measurement of load <ol style="list-style-type: none"> a. Welded joints b. Riveted and bolted joints 7. In addition, justify your findings. 8. Design a screw jack. 9. Design a software in some high level language or excel sheets for design of a component 9. Mini Project: Each student will be given a real life problem for the complete design of a subsystem/system using either manual calculation with the help of design handbook or through computer programme, if needed. This will be done as home assignment to be submitted at the end of the semester. 				



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Equipments/ Machines Required	Study work
Course outcomes	After the completion of course: <ul style="list-style-type: none">• The students will demonstrate the ability to apply the fundamentals of stress analysis, theories of failure and material science in the design of machine components.• The students will demonstrate the ability to make proper assumptions, perform correct analysis while drawing upon various mechanical engineering subject areas.• Specifically, the students will demonstrate the preceding abilities by performing correctly:<ul style="list-style-type: none">➤ The design, analysis and sizing of shafts➤ The selection, sizing and analysis of springs➤ The selection of bearing types, and sizing and analysis of rolling element bearings➤ The selection, sizing, design , and analysis of other mechanical components/systems



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Course Title	DYNAMICS OF MACHINES-LAB				
Course Code	BENME502P				
Course Credits	L	T	P	TC	
	-	-	4	2	
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none">• To teach students concept of generalized forces and the principle of virtual work.• To teach students concept of static and dynamic mass balancing and flywheels.• To introduce the approaches and mathematical models used dynamical analysis of machinery.				
Course Contents	<p>List of Experiments to be Performed (Minimum ten experiments are to be performed by each student)</p> <ol style="list-style-type: none">1. To find out the oscillations of simple pendulum with universal vibration apparatus.2. To find out the oscillations of Compound pendulum with universal vibration apparatus.3. To find out the radius of gyration of bi-filler suspension with universal vibration apparatus.4. To find out undamped torsional vibrations of single rotor system with universal vibration apparatus.5. To find out the frequency of damped torsional vibration of single rotor system with universal vibration apparatus.6. To measure the frequency of torsional vibrations of single rotor system with universal vibration apparatus.7. To measure the frequency of torsional vibrations of double rotor system with universal vibration apparatus.8. To find out free vibration of helical coiled spring with universal vibration apparatus.9. To study forced damped vibration of a spring mass system and simple supported beam with universal vibration apparatus.10. To find out the Gyroscopic couple and prove the Gyroscopic law with Gyroscope apparatus.11. To find out the Power and effort of Proel, Porter & Hartnell Governor with Governor Apparatus.				



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

	<p>12. To find out the critical speed for different diameters of shaft by whirling of shaft apparatus.</p> <p>13. To verify the static and dynamic balancing for different planes and masses by balancing apparatus.</p>
Equipments/ Machines Required	<p>LIST OF EQUIPMENTS/MACHINES REQUIRED</p> <ol style="list-style-type: none">1. Universal Vibration Apparatus2. Whirling of Shaft Apparatus.3. Balancing Apparatus (Both Static & Dynamic)4. Epicyclic Gear Train and Holding Torque Apparatus5. Gyroscope apparatus6. Governor apparatus with differential attachments
Course outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none">• Mastery of the knowledge in dynamics of planar mechanism.• Analyze static and dynamic force analysis of mechanisms.• Take notice of importance of the balancing and learn procedures of the basic balancing.• Ability to understand the implications of computed results in dynamics to improve the design of a mechanism



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Course Title	FLUID MACHINERY -LAB				
Course Code	BENME504P				
Course Credits	L	T	P	TC	
	-	-	4	2	
Course Objectives	This course will enable students to: <ul style="list-style-type: none">• The objective of this laboratory is to determine the various parameters related to fluid flow in pipes and in open channels.• To impart practical exposure on the performance evaluation methods of various flow measuring equipment and hydraulic turbines and pumps.				
Course Contents	List of Experiments/Studies to be Performed (Minimum seven experiments and three studies are to be performed by each student) <ol style="list-style-type: none">1. Performance characteristics of Pelton wheel turbine.2. Performance characteristics of Francis turbine.3. Performance characteristics of Kaplan turbine.4. Performance characteristics of variable speed centrifugal pump.5. Performance characteristics of rated speed centrifugal pump.6. Performance characteristics of multistage centrifugal pump.7. Study of Wind Tunnel (Open Circuit blower type)8. Determination of Lift and drag force over an air foil.9. To study the working of fluidic devices (Analog and Digital)10. To study the Hydraulic Accumulator11. To study the Hydraulic Intensifier12. To study the Hydraulic Crane13. To study the Hydraulic lift14. To study the Hydraulic Ram15. To study the Jet Pump16. To study the Air Lift Pump				
Equipments/ Machines Required	List of Equipments/Machines Required: <ol style="list-style-type: none">1. Pelton Wheel Turbine2. Francis Turbine Test Rig				



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

	<ol style="list-style-type: none">3. Kaplan Turbine Test Rig4. Variable Speed Centrifugal Pump Test Rig5. Rated Speed Centrifugal Pump Test Rig6. Multi Stage Centrifugal Pump Test Rig7. Reciprocating Pump Test Rig8. Complete setup of Wind Tunnel (Open circuit blow type) with minimum wind speed not less than 30m/sec.9. Fluidic devices (Analog and Digital)10. Airofoil with the provision of measurement of pressure distribution over the surface.11. Cut section model of Hydraulic Accumulator12. Cut section model of Hydraulic Intensifier13. Cut section model of Hydraulic Crane14. Cut section model of Hydraulic Lift15. Cut section model of Hydraulic Ram16. Cut section model of Hydraulic Jet and Air lift pump.
Course outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none">• The laboratory provides training to undergraduate and graduate students in flow measurements.• The areas of research include flow imaging, control, jets and wakes, micro-scale transport, and interfacial fluid dynamics.• Perform experiments to determine the coefficient of discharge of flow measuring devices.• Conduct experiments on hydraulic turbines and pumps to draw characteristics.• Test basic performance parameters of hydraulic turbines and pumps and execute the knowledge in real life situations.• Determine the energy flow pattern through the hydraulic turbines and pumps.• Exhibit his competency towards preventive maintenance of hydraulic turbines.



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Course Title	MANUFACTURING SCIENCE -LAB				
Course Code	BENME505P				
Course Credits	L	T	P	TC	
	-	-	4	2	
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none">• This course is to give a broad understanding of conventional and non-conventional machining processes with an emphasis on the characterization techniques.• This course also familiarizes students with the scientific principles governing various machining processes.				
Course Contents	<p>List of Experiments to be Performed (Minimum ten experiments are to be performed by each student)</p> <p>Foundry</p> <ol style="list-style-type: none">1. Moulding of a multi-piece pattern by green sand moulding2. Making a mould (with core) and casting. <p>Machine Tool</p> <ol style="list-style-type: none">3. Taper turning in a Lathe4. Thread cutting in Lathe5. Slot cutting in Shaper6. Gear cutting in milling machine using indexing head.7. Alignment testing of Lathe8. Drilling, boring and reaming of a hole. <p>Cutting Tool</p> <ol style="list-style-type: none">9. Study of turning tool of Lathe (Tool signature)10. Study of twist drill <p>Welding</p> <ol style="list-style-type: none">11. Joining MS plates by arc welding (SMAW,MIG)12. Joining metal sheet by resistance welding13. Joining metal by soldering/brazing <p>Inspection and Testing</p> <ol style="list-style-type: none">14. Inspection of casting defect and welding defects				



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

	15. Non destructive testing of casting and welding defects
Equipments/ Machines Required	LIST OF EQUIPMENTS/MACHINES REQUIRED 1. Moulding equipment 2. Melting facility 3. Lathe 4. Shaper 5. Drilling Machine 6. Milling Machine 7. Reamers 8. Arc welding equipments 9. Soldering /Brazing equipments 10. Non destructive testing equipments
Course outcomes	After the completion of course: <ul style="list-style-type: none">• Understand the idea for selecting materials for patterns. Types and allowances of patterns used in casting and analyze the components of moulds.• Design core, core print and gating system in metal casting processes• Understand the application of arc and gas welding in industries, solid state and resistance welding processes.• To understand the working principle of inert and solid type welding process• Develop process-maps for metal forming processes using plasticity principles. Identify the effect of process variables to manufacture defect free products.