Shri Rawatpura Sarkar University, Raipur

Examination Scheme & Syllabus

for

B.Tech in Mechanical Engineering

Semester-VI

(Effective from the session: 2022-23)

SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Four Years B.Tech. Programmme
Scheme of Teaching and Examination
B.Tech. Sixth 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.	BENME601T	Machine Design – II	3	1	-	4	**30**	**70**	**100**	**3**
2.	BENME601P	Machine Design-II Lab	-	-	4	2	**15**	**35**	**50**	**-**
3.	BENME602T	Energy Systems	3	1	-	4	**30**	**70**	**100**	**3**
4.	BENME603T	Internal Combustion Engines	3	1	-	4	**30**	**70**	**100**	**3**
5.	BENME603P	Internal Combustion Engines Lab	-	-	4	2	**15**	**35**	**50**	**-**
6.	BENME604T	Heat & Mass Transfer	3	1	-	4	**30**	**70**	**100**	**3**
7.	BENME604P	Heat & Mass Transfer Lab	-	-	4	2	**15**	**35**	**50**	**-**
8.	BENME605T	Production Management	3	1	-	4	**30**	**70**	**100**	**3**
9.	BENME606T	Professional Elective-I	3	1	-	4	**30**	**70**	**100**	**3**
10	BENME607P	Industrial training/seminar	-	-	4	2	**15**	**35**	**50**	**-**
						32			**800**	

Professional Elective-I			
S. No.	**Board of Study**	**Subject Code**	**Subject**
1	Mechanical Engineering	BENME606A	Industrial Hydraulics
2	Mechanical Engineering	BENME606B	Power Plant Engineering
3	Mechanical Engineering	BENME606C	Maintenance and Reliability

Course Title	**MACHINE DESIGN – II**				
Course Code	**BENME601T**				
Course Credits	**L**	**T**	**P**	**TC**	
	3	**1**	**-**	**4**	
Prerequisites	Understanding of basic concept of Statics and free body diagrams, material science, mechanics of materials, stress analysis, deflection analysis, reliability analysis, static failure theories, fatigue-failure theories.				
Course Objectives	**This course will enable students to:** • To design and analyze coil, leaf and laminated springs. • To design and analyze spur, helical and bevel gears. • To design and analyze rolling contact bearings. • To design and analyze journal bearing. • To design and analyze chain and belt drive.				
Course Contents	**UNIT – I** **Spring:** Spring materials and their mechanical properties, equation for stress and deflection, helical coil springs of circular section for tension, compression and torsion, dynamic loading, fatigue loading, Wahl line, leaf spring and laminated spring. **UNIT - II** **GEARS: Spur Gears :** Gear drives, classification of gears, selection of type of gears, law of gearing, force analysis, gear tooth failures, selection of material, number of teeth, face width, beam strength of gear tooth, effective load on gear tooth, estimation of module based on wear strength, lewis equation, gear design for maximum power transmitting capacity, gear lubrication. **UNIT - III** **Helical Gears:** Helical gears, terminology of helical gears, virtual number of teeth, tooth proportions, force analysis, beam strength of helical gears, effective load on gear				

	tooth, wear strength of helical gears. **Bevel Gears:** Bevel gears, terminology of bevel gears, force analysis, beam strength of bevel gears, wear strength of bevel gears, effective load on gear tooth. **UNIT - IV** **Bearings: Rolling Contact Bearings:** Types of ball and roller bearings, selection of bearing for radial and axial load, bearing life, Mounting and lubrication, shaft scales – contact type and clearance type. **Journal Bearings:** Types of lubrication, viscosity, Hydrodynamic theory of lubrication, Somerfield number, heat balance, self-contained bearings, bearing materials. **UNIT - V** **Chain Drives:** Chain drives, roller chains, geometric relationships, dimensions of chain components polygonal effect, power rating of roller chains. **Belt Drives:** Flat and V-belts, belt constructions, geometrical relationships for length of the belt, analysis of belt tensions, condition for maximum power, selection of flat & V-belts, adjustment of belt tensions, Wire ropes, stresses in wire ropes.
Course outcomes	**After the completion of course:** • 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, analysis, and solve mechanical engineering problems useful to the society. • Work effectively with engineering and science teams as well as with multidisciplinary designs.
Text Books	1. Design of Machine Elements- V.B.Bhandari - TMH, New Delhi 2. Mechanical Engineering Design - Shigley – McGraw Hill, Delhi

Reference Books	1. Machine Design - Movnin – MIR Publishers,Moscow 2. Machine Design - Fundamental & Application – Gope –PHI, New Delhi 3. Machine Design - Sharma &Agrawal – Katson, New Delhi 4. Principles of Mechanical Design - R. Phelan – McGraw Hill, New Delhi. 5. Machine Design – Sundarajamoorthy&Shanmugum– Anuradha Agencies, Chennai

Course Title	**ENERGY SYSTEMS**				
Course Code	**BENME602T**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**1**	**-**	**4**	
Prerequisites	Understanding of basic concept of physics, Numerical analysis and basic thermodynamics. Basic knowledge about non-conventional energy resources.				
Course Objectives	**This course will enable students to:** • To understand the construction and operation of various jet and rocket engine. • To analyze jet engine and rocket engine from fluid and thermodynamic principle. • To study important non-conventional energy resources and the technologies for harnessing these.				
Course Contents	**UNIT – I** **Propulsion Devices:** Types of jet engines, Ram Jet, pulse jet, Turbojet, Turbo propulsion, principle and operation. Energy flow through jet and variation of pressure and temperature, thrust equation, specific thrust and velocity of fluid. Thermodynamics of turbojet, efficiency & performance, parameters affecting performance, after burn, Injection of water & alcohol mixture. **UNIT - II** **Rocket Propulsion:** Basic theory, Physics equations, classifications, types of rocket engines, liquid propellant rockets, efficiency and performance, orbital & escape velocity application of space flight. **UNIT - III** **Non-Conventional Energy Conversion:** Classical sources of energy crisis and search for alternative sources of energy. **Solar energy:** Introduction, earth sun angles, resolution, solar measurement, collection of solar				

	energy, flat plate and focusing collector analysis, calculations, design parameters. Applications of solar energy. Introduction to photovoltaic cell energy conversion techniques. **UNIT - IV** **Bio-Mass:** Introduction, Bio-mass conversion technologies, bio-gas generation, classification of bio-gas plant, Gasifiers, Gobar gas plant, applications. **Wind Energy:** Basic principles of wind energy conversion, wind energy estimation, site selection consideration, basic components of wind energy conversion system, classification, advantages & disadvantages of WECS. **UNIT – V** **Additional Alternate Energy Sources & Improved Energy Utilization:** Fuels cell technology, wave energy conversion, tidal energy conversion, ocean thermal energy conversion (OTEC). Principle of Magneto hydrodynamics (MHD)power system, types of MHD system, advantages, materials for MHD system. Geothermal energy, nature of geothermal fields, geothermal sources, prime movers for geothermal energy, advantages, disadvantages of geothermal energy over other energy forms, its application.
Course outcomes	**After the completion of course:** • Demonstrate a basic understanding of jet and rocket engine design, function and performance. • Acquire knowledge and hands-on competence in the design and development of mechanical systems. • Compare different non-conventional energy resources and choose the most appropriate based on local conditions. • Perform simple techno-economical assessments of non-conventional energy resources. • Perform and compare basic environmental assessments of non-conventional energy resources and conventional fossil fuel systems. • Design renewable/hybrid energy systems that meet specific energy demands, are economically feasible and have a minimal impact on the environment
Text Books	1. Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion – S.M.Yahya – New Age International Publishers, Delhi 2. Non-Conventional Energy Sources - G.D. Rai – Khanna Publishers.

Reference Books	1. Gas Dynamics & Space Propulsion – N. Shanmugam, M. Palani – Anuradha Agencies. 2. Fundamental of Compressible Fluid Dynamics – P. Balachandran – PHI. 3. Gas Turbine Theory & Jet Propulsion – J.K. Jain – Khanna Publishers,Delhi 4. Solar Energy -Fundamentals and Applications– H.P.Garg & J. Prakash – TMH ,Delhi 5. Non Conventional Energy Sources – Saeed, Hasan and DK Sharma, SK Kataria,Delhi 6. Non Conventional Energy Resources- DSChauhan, and Srivastava, New Age,Delhi 7. Biogas Technology-B.T.Nijaguna,- New Age ,Delhi 8. Solar Energy – Principles of Thermal Collection and Storage- R Sukhatme- THM Delhi 9. Non Conventional Energy Resources: Alternative Energy Sources And Systems- R.K.Singhal, Kataria ,Delhi

Course Title	**INTERNAL COMBUSTION ENGINES**				
Course Code	**BENME603T**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**1**	**-**	**4**	
Prerequisites	Basic knowledge of how the design and operation of internal combustion engines affect their performance, efficiency, fuel requirements, and environmental impact. The understanding of basic concept of applied thermodynamics.				
Course Objectives	**This course will enable students to:** • To study classifications of internal combustion engine. • To understand how and why actual cycles deviate from air standard cycle and fuel-air cycle. • To understand combustion in spark ignition engine and diesel engines. • To impart knowledge on fuel and its specifications. • To impart knowledge about carburetion, gasoline injection and diesel injection. • To impart knowledge about ignition, cooling, lubrication and governing systems. • To impart knowledge about various engine performance characteristics and its testing				
Course Contents	**UNIT – I** **Introduction:** Internal and external combustion engine and their comparison, four stroke cycle S.I. and C.I. engine, two stroke engine, comparison of four stroke and two stroke engines, comparison of S.I. and C.I. engine, classification of I.C. Engine on various basis Valve timing diagram for S.I. and C.I. engines. Effect of valve timing and engine speed on volumetric efficiency. **Fuel-air cycles and actual cycle:** Reasons for deviation of actual cycle from air standard cycles, fuel air cycles and their analysis, actual cycles and their analysis. Reasons of ignition advance and injection advance.				

UNIT - II

Combustion:

Combustion in S.I. engine, stages of combustion, factor influencing the flame speed, the phenomenon of knock in S.I. engine, effect of engine variable on knock, effects of detonation, Pre-ignition, effect of preignition. Combustion in C.I. engine: stages of combustion, factor influencing the delay period, the phenomenon of knock in C.I. engine, effect of engine variable on knock, comparison between knock in S.I. and C.I. engine.

Fuels:

Basic requirement of I.C. Engine fuels, requirement of an ideal gasoline, structure of petroleum, effect of fuel structure on combustion, volatility of liquid fuels, ASTM distillation curve, effect of volatility on engine performance - cold starting, hot starting, vapour lock, acceleration, carburetor icing, and crank case dilution. Antiknock rating of fuels, CCR, HUCR, Octane number, performance number, Cetane number. Dopes.

UNIT - III

Carburetion:

Properties of air-petrol mixtures, mixture requirement, simple carburetor, limitation of simple carburetor, Nozzle lip, venturi depression, calculation of fuel jet and venturi throat diameter for given air fuel ratio. Element of complete carburetor, main metering system-compensating jet device, Idling system, power enrichment system, acceleration pump and cold starting system. Gasoline injection system: Disadvantages of carburetor, Type of injection system, components of injection system, Electronic gasoline fuel injection system, multi-point fuel injection system, working, advantages and disadvantages.

UNIT - IV

Injection System for C.I. Engines:

Requirement, type of injection systems, Bosch fuel injection pump, type of fuel injector, type of nozzle, atomization, spray penetration and spray direction. Electronic diesel injection System.

Ignition System:

Battery and magneto ignition system and their comparative study, spark plug heat range, electronic ignition system, firing order, Ignition timing, centrifugal and vacuum ignition advance.

Cooling System:

Cooling requirement, air cooling, liquid cooling, type of liquid cooling system, advantage and disadvantage of air cooling and water cooling system, Antifreeze

	mixture. **Lubrication System:** Function of lubricating system, Classification of lubricating system, mist lubrication system, dry sump lubrication, wet sump lubrication-splash, and modified and full pressure system **UNIT – V** **Governing:** Necessity of governing, methods of governing-hit and miss governing, quantity governing and quality governing. **Testing and Performance:** Performance parameters, measurements of brake power, indicated power, measurement friction power-Willan's line method, Morse test, motoring test, measurement fuel consumption, and measurements of air consumption, exhaust gas calorimeter. Calculation of various performance parameter, heat balance sheet and heat balance diagram. Performance curves of S.I. and C.I. Engine at full throttle variable speed operation and at constant speed variable load operation.
Course outcomes	**After the completion of course:** 1. Demonstrate a basic understanding of engine design, function and performance. 2. Acquire knowledge and hands-on competence in the design and development of mechanical systems. 3. Work effectively with engineering and science teams as well as with multidisciplinary designs. 4. Demonstrate an understanding of the relationships between the design of the internal combustion engine and environmental issues.
Text Books	3. A Course in Internal Combustion Engines – M.L. Mathur & R.P. Sharma – Dhanpat Rai & Sons,Delhi 4. Internal Combustion Engine – V. Ganeshan – TMH, New Delhi
Reference Books	1. Internal Combustion Engine – R. Yadav – Central Publishing House, Allahabad 2. A Course in Internal Combustion Engine – V.M. Domkundwar – Dhanpat Rai & Sons,Delhi 3. Internal Combustion Engines – R.K.Rajput – Laxmi Publications

	4. Internal Combustion Engine Fundamentals-John B. Heywood- McGraw Hill International, Delhi 5. Fundamental of Internal Combustion Engine – Paul W. Gill, James H. Smith, Eugene – Oxford and IBH Publishing Company 6. Fundamental of Internal Combustion Engine- H.N. Gupta-PHI- New Delhi 7. Engineering Fundamentals of the Internal Combustion Engine- Pulkrabek, Willard W-PHI Delhi 8. Elements of Internal Combustion Engines- A R Rogowski- TMH. New Delhi 9. Automotive Mechanics: Principles And Practices- W.H.Crouse, and D.L. Anglin, TMH ,Delhi

<table>
<tr><td>Course Title</td><td colspan="5">HEAT & MASS TRANSFER</td></tr>
<tr><td>Course Code</td><td colspan="5">BENME604T</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>4</td><td>1</td><td>-</td><td>4</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Basic knowledge of conservation equations, conduction heat transfer, forced and natural convective heat and momentum transfer in laminar and turbulent flows, thermal radiation, mass diffusion.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">This course will enable students to:
To provide a fundamental understanding of the principles of heat transfer due to conduction, convection and radiation.
To achieve an understanding of the basic concepts of phase change processes.
To understand the principles of mass transfer.
To learn about the design of heat exchangers.</td></tr>
<tr><td>Course Contents</td><td colspan="5">UNIT – I
Introduction:
Heat transfer, Difference between heat transfer and thermodynamics, Various modes of heat transfer, Fourier’s, Newton’s and Stefan Boltzman’s Law, Combined modes of heat transfer, thermal diffusivity, overall heat transfer coefficient. The thermal conductivity of solids, liquids and gases, factors influencing conductivity
Conduction :
Heat conduction without heat generation: Derivation of general differential equation of heat conduction in Cartesian co-ordinate. One dimensional steady state conduction, linear heat flow through a plane and composite wall, heat conduction without heat generation in cylinder and sphere, critical thickness of insulation. Conduction with heat generation in flat wall and solid cylinder.
UNIT - II
Heat transfer from extended surface (Fins):
Types of fins, Fin equation for uniform cross sectional area (rectangular profile), Solution for infinite length, negligible heat loss from fin tip, finite long and heat transfer from fin tip. Fin effectiveness and efficiency. Error in temperature</td></tr>
</table>

measurement from thermometer.

Transient/Unsteady State Heat Conduction:

Lumped system analysis, criteria for lumped system analysis, solution of transient heat conduction in large plane wall, long cylinders and sphere through Heisler`s chart.

UNIT - III

Forced Convection:

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

Natural Convection:

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

UNIT - IV

Two Phase Heat Transfer:

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

Introduction to Mass Transfer :

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

UNIT – V

Heat Exchangers:

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

Thermal Radiation:

Introduction, absorptivity, reflectivity & transmissivity. Concept of black body & grey body. Emissive power of surface, Kirchoff's law, emissivity , Concept of shape factor. Radiat heat exchange between two parallel grey surface and concentric cylinders. Errors in temperature measurement due to radiation.

	Concept of irradiation and radiosity.
Course outcomes	**After the completion of course:** • Apply knowledge of heat transfer for understanding, formulating and solving engineering problems. • Acquire knowledge and hands-on competence in applying the concepts of heat and mass transfer 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, analysis, and solve mechanical engineering problems useful to the society. • Work effectively with engineering and science teams as well as with multidisciplinary designs.
Text Books	1. Heat Transfer – S.P. Sukhatme – TMH,Delhi 2. Heat & Mass Transfer – D.S. Kumar – S.K. Kataria & Sons,Delhi
Reference Books	1. Heat transfer- C P Arora, TMH,Delhi 2. Heat & Mass Transfer – R, Yadav, Central Publishing House, Allahabad 3. Heat & Mass Transfer – R.K. Rajput, S.Chand, Delhi 4. Heat & Mass Transfer – P.K. Nag, TMH, Delhi 5. Heat Transfer – J.P. Holman – TMH, Delhi 6. Heat Transfer – A Practical Approach – Yunus A. Cengel – McGraw Hill ,Delhi 7. Heat And Mass Transfer Fundamentals And Applications- Cengel, Yunus, A and AJ Ghajar, TMH, Delhi 8. A Course In Heat And Mass Transfer- S.C. Arora & S Donkundwar, S-Dhanpat Rai,Delhi 9. Heat and Mass Transfer Data Book- C.P.Kothandaraman C.P. & S. Subramanyan , New Age, Delhi

Course Title	**PRODUCTION MANAGEMENT**				
Course Code	**BENME605T**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**1**	**-**	**4**	
Prerequisites	Understanding of basic concept of commerce, production engineering and managerial processes.				
Course Objectives	**This course will enable students to:** • To understand the basic concept of production management. • To understand the concept of breakeven analysis. • To learn the different methods to solve problems in sales forecasting. • To understand the concept of planning, organizing & controlling. • To understand the various models of inventory control. • To understand the methods of purchasing & store keeping. • To understand & analyze the various methods of quality control problems.				
Course Contents	**UNIT – I** **Production Management:** definition, objectives, scope, benefits, functions of production management, place of production management in an organization, types of production system, Product life cycle, product design and development, production cycle. **Costing and Cost Analysis:** Elements of costs, Break even analysis, Incremental costs, make or buy decision. **UNIT - II** **Sales Forecasting**: Purposes, methods -Delphi, linear regression, economic indicators, time-series analysis, adjustment for seasonal variations, moving average, exponential smoothing. **UNIT - III** **Production Planning and Control:** Functions, Organization, Master Scheduling, Aggregate planning and strategies				

	,Materials Requirement Planning, product structure tree, Routing, Loading Scheduling –forward and backward, Dispatching –priority rules, Sequencing, Johnson's algorithm for n jobs and two machines, Gantt's chart, Bar chart, Flow process chart. **Materials Handling:** Principles of materials handling, unit load, Types of materials handling equipment, Relation between materials handling and plant layout. **UNIT - IV** **Material Management:** Objectives and functions of materials management, Organization of materials management. **Procurement:** Objectives of purchase department, purchase responsibilities and organization, types of purchasing, purchase procedures, Import and Export. **Stores Keeping:** Stores management, functions of stores, classification of materials, standardization of materials, identification and maintenance of layout of stores, physical control of materials, pricing of stores, issuing of stores. **Inventory Control:** Objective, scope and functions of inventory control, inventory control techniques, economic ordering quantity, periodic ordering quantity, A.B.C. analysis, General idea regarding inventory control under risk and uncertainty. **UNIT – V** **Quality Control:** Difference between inspection and quality control, acceptance sampling, procedure's risk and consumer's risk, operating characteristic curve for single sampling plan, AOQL Quality of conformance, quality of design, economics of quality, SQC charts for variables and attributes. Introduction to JIT manufacturing, Kanban system.
Course outcomes	**After the completion of course:** • Acquire knowledge recognize and perform the job of a competent production manager. • Identify, analyze and solve production engineering related problems in planning, decision-making, and expense control.

	• Understand the performance to establish setting goals & predicting expenses and planning budgets. • Work effectively with engineering and science teams as well as with multidisciplinary designs. • Skillfully use modern engineering tools and techniques in various production areas. • Additionally, this course will help the student to be a committed to quality, timeliness, and continuous improvement. • Pursue higher studies.
Text Books	1. Production and operation Management–By P. Ramamurty –New Age International Publication,New Delhi 2. Production and operation Management –By R. Mayer –TMH,New Delhi 3. Quality Planning and Analysis, Juran and Gryna
Reference Books	1. Industrial Engineering & Production Management –Martand Telsang, S.Chand & Co. 2. Production and operations Management by –Adam and Ebert –PHI ,New Delhi 3. Production planning and Control –By Samuel Eilon, Navneet Prakashan Ltd., Bombay.

<table>
<tr><td>Course Title</td><td colspan="5">MACHINE DESIGN-II LAB</td></tr>
<tr><td>Course Code</td><td colspan="5">BENME601P</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>-</td><td>-</td><td>4</td><td>2</td><td></td></tr>
<tr><td>Course Objectives</td><td colspan="5">This course will enable students to:
To illustrate to students the variety of mechanical components available and emphasize the need to continue learning.
To teach students how to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems.</td></tr>
<tr><td>Course Contents</td><td colspan="5">Students have to solve at least four design problems out of the below mentioned topics
Design of gears of a two stage gear-box (spur, helical or bevel)
Design of a leaf spring for a given specification
Design of chain drive for a given specification
Design of belt drive for a given specification
Design of rolling element bearing for a given specification
Design of journal bearing for a given specification
B. Writing Computer programme for conventional design:
Students are required to write computer program and validate it for the design of machine components done in theory subject.
C. Mini Project:
Each student will be given a real life problem (as below) 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.
Design the transmission system for an overhead crane assuming suitable data
Design the transmission system for a lathe machine assuming suitable data
Design the transmission system for an automobile assuming suitable data
Design the transmission system for a shaper machine assuming suitable data
Design the transmission system for a flour mill assuming suitable data</td></tr>
</table>

	➢ Design the transmission system for a crusher machine assuming suitable data The design must contain design of shafts, keys, couplings, clutch, pulleys/chain/gear drives, and bearings. The results must be plotted in the form of two dimensional drawings (manually/using software) both in component level and assembly level.
Course outcomes	**After the completion of course:** • How to select appropriate gears for power transmission on the basis of given load and speed. • Design gears based on the given conditions. • How to select bearings for a given applications from the manufacturers catalogue. • Select and/or design belts and flywheel for given applications • Design cam and follower mechanisms. Design clutches and brakes
Equipment's/ Machines Required	

Course Title	**INTERNAL COMBUSTION ENGINES-LAB**				
Course Code	**BENME603P**				
Course Credits	**L**	**T**	**P**	**TC**	
	-	**-**	**4**	**2**	
Course Objectives	**This course will enable students to:** • The main objective of this lab is to develop an idea of fuel properties and their variation with temperature, determination of kinematic viscosity and calorific value of fuels. • Understanding of basic internal combustion engine performance. • determination of friction power and volumetric efficiency of I.C.				
Course Contents	**Students have to solve at least four design problems out of the below mentioned topics** ➢ Design of gears of a two stage gear-box (spur, helical or bevel) ➢ Design of a leaf spring for a given specification ➢ Design of chain drive for a given specification ➢ Design of belt drive for a given specification ➢ Design of rolling element bearing for a given specification ➢ Design of journal bearing for a given specification **B. Writing Computer programme for conventional design:** Students are required to write computer program and validate it for the design of machine components done in theory subject. **C. Mini Project:** Each student will be given a real life problem (as below) 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. ➢ Design the transmission system for an overhead crane assuming suitable data ➢ Design the transmission system for a lathe machine assuming suitable data ➢ Design the transmission system for an automobile assuming suitable data ➢ Design the transmission system for a shaper machine assuming suitable data ➢ Design the transmission system for a flour mill assuming suitable data				

	➢ Design the transmission system for a crusher machine assuming suitable data The design must contain design of shafts, keys, couplings, clutch, pulleys/chain/gear drives, and bearings. The results must be plotted in the form of two dimensional drawings (manually/using software) both in component level and assembly level.
Equipments/ Machines Required	1. Working model of gear transmission system. 2. Cut section of two strokes S.I. engine. 3. Cut section of two strokes C.I. engine. 4. Cut section of four strokes S.I. engine. 5. Cut section of four strokes C.I. engine. 6. Working model of chain and belt drive system.
Course outcomes	**After the completion of course:** • Demonstrate the working of different systems and processes of S.I. engines • Demonstrate the working of different systems and processes of C.I. engines • Illustrate the working of lubrication, cooling and supercharging systems. • Analyze engine performance • Illustrate emission norms and emission control. • Comprehend the different technological advances in engines and alternate fuels.

Course Title	**HEAT & MASS TRANSFER-LAB**				
Course Code	**BENME604P**				
Course Credits	**L**	**T**	**P**	**TC**	
	-	**-**	**4**	**2**	
Prerequisites	This course is designed to introduce a basic study of the phenomena of heat and mass transfer, to develop methodologies for solving a wide variety of practical engineering problems, and to provide useful information concerning the performance and design of particular systems and processes.				
Course Objectives	**This course will enable students to:** • This course is designed to introduce a basic study of the phenomena of heat and mass transfer. • To develop methodologies for solving a wide variety of practical engineering problems, and to provide useful information concerning the performance and design of particular systems and processes.				
Course Contents	**List of Experiments (At least Ten experiments are to performed by each student):** 1. To Determine Thermal Conductivity of Insulating Powders. 2. To Determine Thermal Conductivity of a Good Conductor of Heat (Metal Rod). 3. To Measure the thermal Conductivity of Liquid. 4. To determine the transfer Rate & Temperature Distribution for a Pin Fin. 5. To Measure the Emmissivity of the Test plate Surface. 6. To Determine Stefan Boltzman Constant of Radiation Heat Transfer. 7. To Determine the Surface Heat Transfer Coefficient For Heated Vertical Cylinder in Natural Convection. 8. Determination of Heat Transfer Coefficient in Drop Wise & Film Wise condensation. 9. To Determine Critical Heat Flux in Saturated Pool Boiling. 10. To Study Performance of Simple Heat Pipes. 11. To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers. 12. To Find the Heat transfer Coefficient in Forced Convection in a tube. 13. To determine the total thermal conductivity and thermal resistance of the given compound resistance in series.				

	14. To find out the thermal conductivity of given slab material. 15. To determine the individual thermal conductivity of different lagging in a lagged pipe. 16. To study the rates of heat transfer for different materials and geometries 17. To understand the importance and validity of engineering assumptions through the lumped heat capacity method. 18. Testing and performance of different heat insulators.
Equipments/ Machines Required	**List of Equipments/Machines required:** 1. Thermal conductivity of insulating powder apparatus 2. Thermal conductivity of metal bar apparatus 3. Thermal conductivity of liquid apparatus 4. Transfer rate and temperature distribution for a pin fin apparatus 5. Emmissivity of the test plate surface apparatus 6. Stefen-Boltzman constant of radiation of heat transfer apparatus 7. Surface heat transfer coefficient for heated vertical cylinder in natural convection apparatus 8. Heat transfer coefficient in drop wise and film wise condensation apparatus 9. Critical heat flux in saturated pool boiling apparatus 10. Performance of different heat pipe apparatus 11. Heat transfer rate through heat exchanger apparatus 12. Heat transfer coefficient in forced convection of air in a tube apparatus 13. Heat transfer through composite wall apparatus 14. Thermal conductivity of insulating slab apparatus 15. Heat transfer through lagged pipe apparatus Testing.
Course outcomes	**After the completion of course:** • Identify the three modes of heat transfer (conduction, convection and radiation). • Illustrate basic modes of heat transfer. • Develop mathematical model for each mode of heat transfer. • Develop mathematical model for transient heat transfer. • Demonstrate and explain mechanism of boiling and condensation. • Analyze different heat exchangers and quantify their performance

Professional Elective-I

Course Title	**INDUSTRIAL HYDRAULICS**				
Course Code	**BENME606A**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**1**	**-**	**4**	
Prerequisites	Understanding of basic concept of Fluid Mechanics & Machinery.				
Course Objectives	**This course will enable students to:** • To learn basic concepts and terminologies of hydraulics. • To understand construction and working of various hydraulic power system. • To understand the constructional details of pumps and actuators. • To understand various valves and auxiliaries & rectification of their problems. • To understand the hydraulic circuits & develop Hydraulic Circuits. • To understand accumulators and intensifiers				
Course Contents	**UNIT – I** **Fluidics:** Technology, Terminology, types of fluid logic elements, amplifiers, logic states, methods of obtaining input signals and power outputs, application of fluidics, third generation fluidics. **UNIT - II** **Hydraulic Fluid:** Types of hydraulic fluids, properties of fluid, selection of fluids, JIC/ISO symbols for hydraulic circuits. **Fluid Power System:** Components, advantages, applications in the field of Machine Tools, material handling, presses, mobile and stationary machines, clamping & indexing devices etc., transmission of power at static and dynamic states. **UNIT - III** **Pumps:** Types, classification, principle and working of vane, gear, radial and axial plunger pumps, power and efficiency calculations, selection of pumps for				

	hydraulic transmission. **Actuators:** Linear and rotary actuators, hydraulic motor types & construction methods of control of acceleration, types of cylinder and mountings, calculation of piston velocity, thrust under static and dynamic application. **UNIT - IV** **Control of Fluid Power:** Principle, working types of the following valves, pressure control, direction control, flow control, relief valves, sequence values etc. **UNIT V** **Hydraulic Circuits:** Meter in, meter out circuits, Pressure control for cylinders, Flow divider circuits, Circuit illustrating use of pressure reducer valves, sequence valve, counter balance valves, unloading valves with the use of electrical control, accumulators etc. **Accumulators and Intensifiers:** Types, function, application, selection and design procedure.
Course outcomes	**After the completion of course:** • Acquire knowledge and hands-on competence in applying the concepts of industrial hydraulics 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, analysis, and solve mechanical engineering problems useful to the society. • Work effectively with engineering and science teams as well as with multidisciplinary designs.
Text Books	5. Hydraulic Machines including fluidics – Dr. Jagdish Lal, Metropolitan Book Company, New Delhi 6. Introduction to Fluid Power – Sahastrabadhe, Nirali Prakashan, Pune
Reference Books	10. Industrial Hydraulics manual by Vickers 11. Industrial Hydraulics – Pipenger & Hicks, Mc Graw Hill Company, New York 12. Hydraulics Vol. 1 & 2 by Rexroth 13. Fluid Power – Goodwin

Course Title	**POWER PLANT ENGINEERING**				
Course Code	**BENME606B**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**1**	**-**	**4**	
Prerequisites	Understanding of basic concept of Production Processes, thermodynamics.				
Course Objectives	**This course will enable students to:** • To impart knowledge on sources of energy and types of power plants. • To understand construction and working of Steam Power Plants, Hydro Electric power station, diesel power station, and Nuclear Power Station. • To impart knowledge about various performance characteristics and its analysis. • To impart knowledge about variable load problem. • To impart knowledge about terms and factors associated with power plant economics				
Course Contents	**UNIT – I** **Elements of Power Plant:** General Sources of power, Importance of Central Power Stations, types of power stations – steam, nuclear, diesel and hydro – Elements of modern power stations (Steams only) brief layout and arrangement of elements and complements, sitting of different power stations, foundation. Elements of Electric power systems primary and secondary distribution substations (in brief). **UNIT - II** **Steam Power Plant:** Steam power plants, selection of working medium, Heat Balance in steam cycles, Heat rates, comparison of efficiencies gas loop, fuels and fuel handling. Equipments, fuel gas cleaning and ash handling. Air pre-heater, feed water pre-heaters, steam re-heaters, deaerators, feed water treatment, pumping and regulation water walls, modern developments in steam boilers, Important instrumentation and piping of gas and water loop. Factors to be controlled from maximum efficiency and variable output.				

	UNIT - III **Hydro Electric power station:** Potential power with reference to rainfall and catchments area, Water storage, equipment used in hydro electric power stations. Characteristics of hydraulic turbines. Comparison of the factors governing the cost of hydro steam and diesel power stations. **Diesel power station:** Suitability of diesel engines for bulk power, advantages and limitations of diesel, power stations, efficiency and heat balance. **UNIT - IV** **Nuclear Power Station:** Evolution of nuclear energy from atoms by fission and fusion. Chain reactions, fission materials, types of reactors, gas cooled, boiling water liquid, metal cooled and fast reactor, arrangements of various elements in a nuclear power station, stem cycles and boilers coolant heat exchangers, Reactor control, Reactor shielding and safety methods. **UNIT V** **Variable load problems:** Idealized and realized load curves, effect of variable load on plant design and operation variable load operation and load dispatch. **Power station Economics:** Source of income, cost of plant and production, elements of cost, depreciation and replacement theory of rates.
Course outcomes	**After the completion of course:** 1. Demonstrate a basic understanding of various types of power plants. 2. Acquire knowledge and hands-on competence in the design and development of mechanical systems associated with power plants. 3. Compare different energy resources and choose the most appropriate based on local conditions 4. Perform simple techno-economical assessments of energy resources. 5. Design power plant that meet specific energy demands, that are economically feasible and have a minimal impact on the environment.
Text Books	1. Power Plant Engineering – P.K. Nag – Tata McGraw-Hill Pub. Com., New Delhi 2. A Course in Power Plant Engineering – S.C. Arora, S.Domkundwar –

	Dhanpat Rai & Co.
Reference Books	1. Text Book of Power Plant Engineering – R.K. Rajput – Laxmi Publications 2. Power Plant Engineering – P.C. Sharma – S.K. Kataria & Sons 3. Power Plant Engineering – G.R. Nagpal – Khanna Publishers 4. Steam and gas turbine and power plant engineering- R. Yadav-CPH Allahabad

Course Title	**MAINTENANCE AND RELIABILITY ENGINEERING**				
Course Code	**BENME606C**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**1**	**-**	**4**	
Prerequisites	Understanding of basic concept of theory of failure, maintenance and manufacturing technique course. Integrating knowledge of design along with other aspects of value addition in the conceptualization and manufacturing stage of various products.				
Course Objectives	**This course will enable students to:** • To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenance activities. • To provide the concept of various types of maintenance system used in industries. • To impart knowledge on reasons for failure and the corrective and preventive measure adopted to reduce them. • To make the students to be familiar with the concept of reliability engineering. • To make the students to understand the various maintenance and logistics means or the execution of various services. • To impart knowledge on creating various tools for maintainability of mechanical system.				
Course Contents	**UNIT I** **Maintenance Engineering:** Objective and functions, organization and administration, economics and maintenance policies. Types of maintenance systems-planned, unplanned, preventive, predictive, conditional monitoring, total predictive maintenance. **UNIT II** **Failure Analysis:** Analysis of source, identification, classification and selectivity of failures, catastrophic, wear out and cumulative failures, failure rate Mortality distribution, statistical and reliability concept of failure analysis, equipment replacement policy. **UNIT III**				

	Reliability Engineering: Concept, bath tub curve, elements, Hazard Models- constant, linearly increasing, weibull. System Reliability - Series configuration, parallel configuration, mixed configuration, reliability improvement – Improvement of components, Redundancy – element, unit, standby, repairable and non repairable systems, reliability, availability, maintainability, MTBF, MTTR, reliability allocation for simple series system. **UNIT IV** **Maintenance Management:** Maintenance planning, maintenance scheduling, work orders, work measurement, maintenance cost budgeting, store and spare control, maintenance planning and control techniques, Incentives for maintenance work. **UNIT V** **Maintenance of Mechanical System:** Introduction, Bearings, Friction Clutches, Couplings, Fastening Devices, Chains, Gear Drives, Support Equipment, Cooling Towers.
Course outcomes	**After the completion of course:** Application of concepts of the course leads to the optimization of equipment, procedures, and departmental budgets to achieve better maintainability, reliability, and availability of equipment.
Text Books	1. Maintenance Engineering & Management – R.C Mishra, K. Pathak – Prentice Hall of India, New Delhi 2. Maintenance Engineering – S. Shrivastava – S. Chand & Sons – New Delhi
Reference Books	1. Industrial Maintenance – H.P. Garg – S. Chand Publication, New Delhi 2. Maintenance Planning & Control – A. Kelly – TMH, New Delhi 3. Concept in Reliability – LS. Srinath – Affiliated East-West Press, New Delhi