Course code	Course Name	L-T-P - Credits	Year of Introduction
HS200	Business Economics	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To familiarize the prospective engineers with elementary Principles of Economics and Business Economics.
- To acquaint the students with tools and techniques that are useful in their profession in Business Decision Making which will enhance their employability;
- To apply business analysis to the "firm" under different market conditions;
- To apply economic models to examine current economic scenario and evaluate policy options for addressing economic issues
- To gain understanding of some Macroeconomic concepts to improve their ability to understand the business climate;
- To prepare and analyse various business tools like balance sheet, cost benefit analysis and rate of returns at an elementary level

Syllabus

Business Economics - basic concepts, tools and analysis, scarcity and choices , resource allocation, marginal analysis, opportunity costs and production possibility curve. Fundamentals of microeconomics - Demand and Supply Analysis, equilibrium, elasticity, production and production function, cost analysis, break-even analysis and markets. Basics of macroeconomics - the circular flow models, national income analysis, inflation, trade cycles, money and credit, and monetary policy. Business decisions - investment analysis, Capital Budgeting decisions, forecasting techniques and elementary Balance Sheet and taxation, business financing, international investments

Expected outcome .

A student who has undergone this course would be able to

i. make investment decisions based on capital budgeting methods in alignment with microeconomic and macroeconomic theories.
ii. able to analyse the profitability of the firm, economy of operation, determination of price under various market situations with good grasp on the effect of trade cycles in business.
iii. gain knowledge on Monetary theory, measures by RBI in controlling interest rate and emerging concepts like Bit Coin.
iv. gain knowledge of elementary accounting concepts used for preparing balance sheet and interpretation of balance sheet

Text Books

1. Geetika, Piyali Ghosh and Chodhury, *Managerial Economics*, Tata McGraw Hill, 2015
2. Gregory Mankiw, *Principles of Macroeconomics*, Cengage Learning, 2006.
3. M.Kasi Reddy and S.Saraswathi, *Economics and Financial Accounting*. Prentice Hall of India. New Delhi.

References:

1. Dornbusch, Fischer and Startz, *Macroeconomics*, McGraw Hill, 11th edition, 2010.
2. Khan M Y, *Indian Financial System*, Tata McGraw Hill, 7th edition, 2011.
3. Samuelson, *Managerial Economics*, 6th edition, Wiley
4. Snyder C and Nicholson W, *Fundamentals of Microeconomics*, Cengage Learning (India), 2010.
5. Truett, Managerial Economics: Analysis, Problems, Cases, 8th Edition, Wiley
6. Welch, *Economics: Theory and Practice* 7th Edition, Wiley
7. Uma Kapila, *Indian Economy Since Independence, 26th Edition: A Comprehensive and Critical Analysis of India's Economy*, 1947-2015
8. C Rangarajan, *Indian Economy, Essays on monetary and finance*, UBS Publishers'Distributors, 1998
9. A.Ramachandra Aryasri, *Managerial Economics and Financial Analysis*, Tata McGraw-Hill, New Delhi.
10. Dominick Salvatore, *Managerial Economics in Global Economy*, Thomas Western College Publishing, Singapore.
11. I.M .Pandey, *Financial Management*, Vikas Publishing House. New Delhi.
12. Dominick Salvatore, *Theory and Problems of Micro Economic Theory.* Tata Mac Graw-Hill, New Delhi.
13. T.N.Hajela.*Money, Banking and Public Finance.* Anne Books. New Delhi.
14. G.S.Gupta. *Macro Economics-Theory and Applications.* Tata Mac Graw- Hill, New Delhi.
15. Yogesh, Maheswari, *Management Economics* , PHI learning, NewDelhi, 2012
16. Timothy Taylor , *Principles of Economics*, 3rd edition, TEXTBOOK MEDIA.
17. Varshney and Maheshwari. *Managerial Economics*. Sultan Chand. New Delhi

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Business Economics** and its role in managerial decision making-meaning-scope-relevance-economic problems-scarcity Vs choice (2 Hrs)-Basic concepts in economics-scarcity, choice, resource allocation- Trade-off-opportunity cost-marginal analysis- marginal utility theory, Law of diminishing marginal utility -production possibility curve (2 Hrs)	4	15%
II	**Basics of Micro Economics I** Demand and Supply analysis-equillibrium-elasticity (demand and supply) (3 Hrs.) -Production concepts-average product-marginal product-law of variable proportions- Production function-Cobb Douglas function-problems (3 Hrs.)	6	15%
FIRST INTERNAL EXAMINATION			
III	**Basics of Micro Economics II** Concept of costs-marginal, average, fixed, variable costs-cost curves-shut down point-long run and short run (3 Hrs.)- Break Even Analysis-Problem-Markets-Perfect Competition, Monopoly and Monopolistic Competition, Oligopoly-Cartel and collusion (3 Hrs.).	6	15%
IV	**Basics of Macro Economics** - Circular flow of income-two sector and multi-sector models- National Income Concepts-Measurement methods-problems-Inflation, deflation (4 Hrs.)-Trade cycles-Money-stock and flow concept-Quantity theory of money-Fischer's Equation and Cambridge Equation -velocity of circulation of money-credit control methods-SLR, CRR, Open Market Operations-Repo and Reverse Repo rate-emerging concepts in money-bit coin (4 Hrs.).	8	15%

SECOND INTERNAL EXAMINATION			
V	**Business Decisions I**-Investment analysis-Capital Budgeting-NPV, IRR, Profitability Index, ARR, Payback Period (5 Hrs.)- Business decisions under certainty-uncertainty-selection of alternatives-risk and sensitivity- cost benefit analysis-resource management (4 Hrs.).	9	20%
VI	**Business Decisions II** Balance sheet preparation-principles and interpretation-forecasting techniques (7 Hrs.)-business financing-sources of capital- Capital and money markets-international financing-FDI, FPI, FII-Basic Principles of taxation-direct tax, indirect tax-GST (2 hrs.).	9	20%
END SEMESTER EXAM			

Question Paper Pattern

Max. marks: 100, Time: 3 hours

The question paper shall consist of three parts

Part A
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

Course No.	Course Name	L-T-P - Credits	Year of Introduction
MA202	Probability distributions, Transforms and Numerical Methods	3-1-0-4	2016

Prerequisite: Nil

Course Objectives

- To introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in various Engineering and social life situations.
- To know Laplace and Fourier transforms which has wide application in all Engineering courses.
- To enable the students to solve various engineering problems using numerical methods.

Syllabus

Discrete random variables and Discrete Probability Distribution.
Continuous Random variables and Continuous Probability Distribution.
Fourier transforms.
Laplace Transforms.
Numerical methods-solution of Algebraic and transcendental Equations, Interpolation.
Numerical solution of system of Equations. Numerical Integration, Numerical solution of ordinary differential equation of First order.

Expected outcome .

After the completion of the course student is expected to have concept of
(i) Discrete and continuous probability density functions and special probability distributions.
(ii) Laplace and Fourier transforms and apply them in their Engineering branch
(iii) numerical methods and their applications in solving Engineering problems.

Text Books:

1. Miller and Freund's "Probability and statistics for Engineers"-Pearson-Eighth Edition.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley, 2015.

References:

1. V. Sundarapandian, "Probability, Statistics and Queuing theory", PHI Learning, 2009.
2. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics"-Sixth Edition.
3. Jay L. Devore, "Probability and Statistics for Engineering and Science"-Eight Edition.
4. Steven C. Chapra and Raymond P. Canale, "Numerical Methods for Engineers"-Sixth Edition-Mc Graw Hill.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Discrete Probability Distributions.** (Relevant topics in section 4.1,4,2,4.4,4.6 Text1)		
	Discrete Random Variables, Probability distribution function, Cumulative distribution function.	2	
	Mean and Variance of Discrete Probability Distribution.	2	
	Binomial Distribution-Mean and variance.	2	
	Poisson Approximation to the Binomial Distribution. Poisson distribution-Mean and variance.	2	15%

II	**Continuous Probability Distributions.** (Relevant topics in section 5.1,5.2,5.5,5.7 Text1) Continuous Random Variable, Probability density function, Cumulative density function, Mean and variance. Normal Distribution, Mean and variance (without proof). Uniform Distribution.Mean and variance. Exponential Distribution, Mean and variance.	 2 4 2 2	15%
FIRST INTERNAL EXAMINATION			
III	**Fourier Integrals and transforms. (**Relevant topics in section 11.7, 11.8, 11.9 Text2) Fourier Integrals. Fourier integral theorem (without proof). Fourier Transform and inverse transform. Fourier Sine & Cosine Transform, inverse transform.	 3 3 3	15%
IV	**Laplace transforms. (**Relevant topics in section 6.1,6.2,6.3,6.5,6.6 Text2**)** Laplace Transforms, linearity, first shifting Theorem. Transform of derivative and Integral, Inverse Laplace transform, Solution of ordinary differential equation using Laplace transform. Unit step function, second shifting theorem. Convolution Theorem (without proof). Differentiation and Integration of transforms.	 3 4 2 2 2	15%
SECOND INTERNAL EXAMINATION			
V	**Numerical Techniques**.(Relevant topics in section.19.1,19.2,19.3 Text2) Solution Of equations by Iteration, Newton- Raphson Method. Interpolation of Unequal intervals-Lagrange's Interpolation formula. Interpolation of Equal intervals-Newton's forward difference formula, Newton's Backward difference formula.	 2 2 3	20%
VI	**Numerical Techniques**. (Relevant topics in section 19.5,20.1,20.3, 21.1 Text2) Solution to linear System- Gauss Elimination, Gauss Seidal Iteration Method. Numeric Integration-Trapezoidal Rule, Simpson's 1/3 Rule. Numerical solution of firstorder ODE-Euler method, Runge-Kutta Method (fourth order).	 3 3 3	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks : 100 Exam Duration: 3 hours

The question paper will consist of 3 parts.

Part A will have 3 questions of 15 marks each uniformly covering modules I and II. Each question may have two sub questions.

Part B will have 3 questions of 15 marks each uniformly covering modules III and IV. Each question may have two sub questions.

Part C will have 3 questions of 20 marks each uniformly covering modules V and VI. Each question may have three sub questions.

Any two questions from each part have to be answered.

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Course code	Course Name	L-T-P-Credits	Year of Introduction
ME202	ADVANCED MECHANICS OF SOLIDS	3-1-0-4	2016

Prerequisite: ME201 Mechanics of solids

Course Objectives: The main objectives of the course are

1. To impart concepts of stress and strain analyses in a solid.
2. To study the methodologies in theory of elasticity at a basic level.
3. To acquaint with the solution of advanced bending problems.
4. To get familiar with energy methods for solving structural mechanics problems.

Syllabus

Introduction, concepts of stress, equations of equilibrium, strain components, strain-displacement relations, compatibility conditions, constitutive relations, boundary conditions, 2D problems in elasticity, Airy's stress function method, unsymmetrical bending of straight beams, bending of curved beams, shear center, energy methods in elasticity, torsion of non-circular solid shafts, torsion of thin walled tubes.

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

1. Apply concepts of stress and strain analyses in solids.
2. Use the procedures in theory of elasticity at a basic level.
3. Solve general bending problems.
4. Apply energy methods in structural mechanics problems.

Text Books:

1. L. S. Sreenath, Advanced Mechanics of Solids, McGraw Hill,2008
2. S. M. A. Kazimi, Solid Mechanics, McGraw Hill,2008
3. S. Jose, Advanced Mechanics of Materials, Pentagon Educational Services,2013
4. L. Govindaraju ,TG Sitharaman, Applied elasticity for Engineers, NPTEL
5. U. Saravanan, Advanced Solid Mechanics, NPTEL
6. S. Anil Lal, Advanced Mechanics of Solids, Siva Publications and Distributions, 2017

References Books:

1. S. P. Timoshenko, J. N. Goodier, Theory of elasticity, McGraw Hill,1970
2. R.J. Atkin, and N. Fox, An introduction the theory of elasticity, Longman,1980
3. J. P. Den Hartog, Advanced Strength of Materials, McGraw Hill,1987
4. C. K. Wang, Applied Elasticity, McGraw Hill,1983
5. www.solidmechanics.org/contents.htm - Free web book on Applied Mechanics of Solids by A.F. Bower.

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	Introduction to stress analysis in elastic solids - stress at a point – stress tensor – stress components in rectangular and polar coordinate systems - Cauchy's equations – stress transformation – principal stresses and planes - hydrostatic and deviatoric stress components, octahedral shear stress - equations of equilibrium	6	15%
	Displacement field – engineering strain - strain tensor *(basics only)* – analogy between stress and strain tensors - strain-displacement relations *(small-strain only)* – compatibility conditions	4	
II	Constitutive equations – generalized Hooke's law – equations for linear elastic isotropic solids - relation among elastic constants – Boundary conditions – St. Venant's principle for end effects – uniqueness theorem	4	15%
	2-D problems in elasticity - Plane stress and plane strain problems – stress compatibility equation - Airy's stress function and equation – polynomial method of solution – solution for bending of a cantilever with an end load	4	
FIRST INTERNAL EXAM			
III	Equations in polar coordinates (2D) – equilibrium equations, strain-displacement relations, Airy's equation, stress function and stress components *(only short derivations for examination)*	3	15%
	Application of stress function to Lame's problem and stress concentration problem of a small hole in a large plate *(only stress distribution)*	3	
	Axisymmetric problems – governing equations – application to thick cylinders,, rotating discs.	4	
IV	Unsymmetrical bending of straight beams *(problems having c/s with one axis of symmetry only)* – curved beams *(rectangular c/s only)* - shear center of thin walled open sections *(c/s with one axis of symmetry only)*	6	15%
	Strain energy of deformation – special cases of a body subjected to concentrated loads, moment or torque - reciprocal relation – strain energy of a bar subjected to axial force, shear force, bending moment and torque	3	
SECOND INTERNAL EXAM			
V	Maxwell reciprocal theorem – Castigliano's first and second theorems – virtual work principle – minimum potential energy theorem.	5	20%

	Torsion of non-circular bars: Saint Venant's theory - solutions for circular and elliptical cross-sections	4	
VI	Prandtl's method - solutions for circular and elliptical cross-sections - membrane analogy.	4	20%
	Torsion of thin walled tubes, thin rectangular sections, rolled sections and multiply connected sections	6	
END SEMESTER EXAM			

Question Paper Pattern

Total marks: 100, Time: 3 hrs
The question paper should consist of three parts

Part A
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3 X10 marks = 30 marks)

Part B
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3 X10 marks = 30 marks)

Part C
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4 X 10 marks = 40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME204	THERMAL ENGINEERING	3-1-0-4	2016

Prerequisite: ME205 Thermodynamics

Course Objectives:

1. To acquire knowledge on the working of steam turbines, IC engines and gas turbines
2. To introduce the combustion process in IC engines
3. To understand air pollution from IC engines and its remedies.

Syllabus

Steam engineering, boilers, steam nozzles, steam turbines, internal combustion engines, performance testing of IC Engines, fuels and fuel combustion, air pollution from IC engines and remedies, combustion in I.C. engines, gas turbines

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

1. Integrate the concepts, laws and methodologies from the course in thermodynamics into analysis of cyclic processes
2. To apply the thermodynamic concepts into various thermal application like IC engines, steam turbines, compressors.

Text Books:

1. Rudramoorthy , Thermal Engineering, McGraw Hill Education India,2003
2. R.K Rajput, Thermal Engineering, Laxmi publications,2010

References Books:

1. V. Ganesan, Fundamentals of IC engines, Tata McGraw-Hill,2002
2. T.D. Eastop and A McConkey, Applied thermodynamics for engineering technology, Pearson education,1996
3. J.B.Heywood, I.C engine fundamentals. McGraw-Hill,2011
4. Gill, P.W., Smith, JR., J.H., and Ziurys, E.J Fundamentals of internal combustion engines Oxford and IBH,1959
5. Rathore**,** Thermal Engineering, McGraw Hill Education India, 2010

Steam Tables

6. R.S.Khurmi, Steam table with Mollier chart,S.Chand,2008

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	Steam engineering- T- S diagram, Mollier chart, Steam cycles- Rankine cycle, Modified Rankine cycle, Relative efficiency, Improvement in steam cycles-Reheat, Regenerative and Binary vapor cycle Steam Boilers: Types of boilers –Cochran boiler, Babcock and Wilcox boiler, Benson boiler, La Mont boiler, Loeffler boiler, Velox boiler, Boiler Mountings and Accessories Steam nozzles:-Types of nozzle- Velocity of steam, mass flow rate, critical pressure ratio and its significance, effect of friction, super saturated flow	8	15%
II	Steam turbines: classification, compounding of turbines-pressure velocity variation, velocity diagrams, work done, efficiency, condition for maximum efficiency, multistage turbines-condition line, stage efficiency. Steam turbine performance-reheat factor, degree of reaction, cycles with reheating and regenerative heating, governing of turbines	8	15%
FIRST INTERNAL EXAM			
III	Internal combustion engines: classification of I.C. Engines- four stroke and two stroke I.C. Engines, Comparison of four stroke and two stroke Engine. Wankel Engine, Air standard cycle-Carnot cycle, Otto cycle; Diesel cycle, dual combustion cycle, comparison of Otto, diesel and dual combustion cycles. Stirling and Ericsson cycles, air standard efficiency, specific work output, work ratio, Actual cycle analysis, deviation of actual engine cycle from ideal cycle. Rotary engines, Stratified charge engine , super charging of SI and CI Engines – turbo charging. Variable specific heats.	10	15%
IV	Performance Testing of I C Engines: Indicator diagram, mean effective pressure. Torque, Engine power- BHP, IHP. Engine efficiency- mechanical efficiency, volumetric efficiency, thermal efficiency and relative efficiency, Specific fuel consumption. Testing of I C engines- Morse test, Heat balance test and Retardation test Fuels and fuel combustion: flash point and fire point, calorific value, Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas. Analysis of fuel combustion-A/F ratio, equivalence ratio, minimum quantity of air, flue gas analysis, excess air.	10	15%
SECOND INTERNAL EXAM			
V	Air pollution from I.C. Engine and its remedies**:** Pollutants from S.I. and C.I. Engines, Methods of emission control, alternative fuels for I.C. Engines; the blending of fuels, Bio fuels. Combustion in I.C. Engines: Combustion phenomena in S.I. engines; Ignition limits, stages of combustion in S.I. Engines, Ignition lag, velocity of flame propagation, auto ignition, detonation; effects of engine variables on detonation; theories of detonation, octane rating of fuels;	10	20%

	pre-ignition; S.I. engine combustion chambers. Stages of combustion in C.I. Engines; delay period; variables affecting delay period; knock in C.I. engines, Cetane rating; C.I. engine combustion chambers.		
VI	Gas turbines: classification, Thermodynamic analysis of gas turbine cycles-open , closed and semi closed cycle; ideal working cycle- Brayton cycle-P-v and T-s diagram, thermal efficiency. Effect of compressor and turbine efficiencies. Optimum pressure ratio for maximum specific work output with and without considering machine efficiencies. Comparison of gas turbine and IC engines, Analysis of open cycle gas turbine, Improvements of the basic gas turbine cycles-regeneration, intercooling and reheating-cycle efficiency and work output-Condition for minimum compressor work and maximum turbine work. Combustion chambers for gas turbines. pressure loss in combustion process and stability loop.	10	20%
END SEMESTER EXAM			

Question Paper Pattern

Total marks: 100, Time: 3 hrs
The question paper should consist of three parts

Part A
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME206	FLUID MACHINERY	2-1-0-3	2016

Prerequisite: ME203 Mechanics of Fluids

Course Objectives:

1. To acquire knowledge on hydraulic machines such as pumps and turbines
2. To understand the working of air compressors and do the analysis

Syllabus

Impact of jets, Hydraulic Turbines, Rotary motion of liquids, Rotodynamic pumps, Positive displacement pumps**,** , Compressors

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

1. Discuss the characteristics of centrifugal pump and reciprocating pumps
2. Calculate forces and work done by a jet on fixed or moving plate and curved plates
3. Know the working of turbines and select the type of turbine for an application.
4. Do the analysis of air compressors and select the suitable one for a specific application

Text Books:

1. Som, Introduction to Fluid Mechanics and Fluid Machines ,McGraw Hill Education India 2011
2. Bansal R. K., A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications,2005.

Reference Books:

1. Cengel Y. A. and J. M. Cimbala, Fluid Mechanics, Tata McGraw Hill, 2013
2. Yahya S. M, Fans, Blower and Compressor, Tata McGraw Hill, 2005.
3. Shepherd D. G, Principles of Turbo Machinery, Macmillan, 1969.
4. Stepanoff A. J, Centrifugal and Axial Flow Pumps, John Wiley & Sons, 1991.
5. Rajput R. K, Fluid Mechanics and Hydraulic Machines, S. Chand & Co.,2006.
6. Subramanya, Fluid mechanics and hydraulic machines, 1e McGraw Hill Education India,2010

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	Impact of jets: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat and curve),– Series of vanes - work done and efficiency Hydraulic Turbines : Impulse and Reaction Turbines – Degree of reaction – Pelton Wheel – Constructional features - Velocity triangles – Euler's equation – Speed ratio, jet ratio and work done , losses and efficiencies, design of Pelton wheel – Inward and outward flow reaction turbines- Francis Turbine – Constructional features – Velocity triangles, work done and efficiencies.	7	15%
II	Axial flow turbine (Kaplan) Constructional features – Velocity triangles- work done and efficiencies – Characteristic curves of turbines – theory of draft tubes – surge tanks – Cavitation in turbines – Governing of turbines – Specific speed of turbine , Type Number– Characteristic curves, scale Laws – Unit speed – Unit discharge and unit power.	7	15%
FIRST INTERNAL EXAM			
III	Rotary motion of liquids – free, forced and spiral vortex flows Rotodynamic pumps- centrifugal pump impeller types,-velocity triangles-manometric head- work, efficiency and losses, H-Q characteristic, typical flow system characteristics, operating point of a pump. Cavitation in centrifugal pumps- NPSH required and available- Type number-Pumps in series and parallel operations. Performance characteristics- Specific speed-Shape numbers – Impeller shapes based on shape numbers.	7	15%
IV	Positive displacement pumps- reciprocating pump – Single acting and double acting- slip, negative slip and work required and efficiency- indicator diagram- acceleration head - effect of acceleration and friction on indicator diagram – speed calculation- Air vessels and their purposes, saving in work done to air vessels multi cylinder pumps. Multistage pumps-selection of pumps-pumping devices-hydraulic ram, Accumulator, Intensifier, Jet pumps, gear pumps, vane pump and lobe pump.	7	15%
SECOND INTERNAL EXAM			
V	Compressors: classification of compressors, reciprocating compressor-single stage compressor, equation for work with and without clearance volume, efficiencies, multistage compressor, intercooler, free air delivered (FAD)	7	20%
VI	Centrifugal compressor-working, velocity diagram, work done, power required, width of blades of impeller and diffuser, isentropic efficiency, slip factor and pressure coefficient, surging and chocking. Axial flow compressors:- working, velocity diagram, degree of reaction, performance. Roots blower, vane compressor, screw compressor.	7	20%
END SEMESTER EXAM			

Question Paper Pattern

Total marks: 100, Time: 3 hrs
The question paper should consist of three parts

Part A
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

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Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME220	MANUFACTURING TECHNOLOGY	3-0-0-3	2016

Prerequisite: Nil

Course Objectives:-

1. To give an exposure to different techniques of casting and molds required.
2. To provide an exposure to different rolling processes and different rolled products
3. To familiarize with different forging methods, cautions to be adopted in die design.
4. To give an introduction to various work and tool holding devices used in manufacturing.
5. To introduce to the bending, shearing and drawing processes of sheet metal working and allied machines,
6. To give an understanding of welding metallurgy and weldability and to introduce various metal joining techniques.

SYLLABUS

Casting –patterns - Cores – Gating – Risering – Defects in Castings - Rolling –Defects in Rolled parts- forging – Coining – Heading – Piercing –Die Design– Extrusion Process– Extrusion Defects – Drawing Process -Principles of Location –Principles of Clamping – Types of Clamp -Sheet metal characteristics –Deep drawing –Spinning –Definition of Welding – Weldability – Solidification of Weld Metal – Heat Affected Zone – Welding Defects - Gas Welding -Arc Welding - Ultrasonic Welding – Friction Welding – Resistance Welding — Brazing- Soldering.

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

1. Acquire knowledge in various casting processes and technology related to them.
2. Understand the rolling passes required for getting required shapes of rolled products.
3. Discuss important aspects of forging techniques
4. Discuss sheet metal working processes and their applications to produce various shapes and products.
5. Acquire knowledge in various types of welding processes.

Text books:-

1. Amitabha Ghosh and Ashok Kumar Mallick, Manufacturing Science Affiliated East West Press Ltd, New Delhi, 2002
2. S.Kalpakjian and Steven R Schimid, Manufacturing Engineering and Technology, Pearson,2001

Reference books:-

1. RAO, Manufacturing Technology-Vol 2 3e, McGraw Hill Education India, 2013
2. RAO, Manutacturing Technology-Vol 1 4e, McGraw Hill Education India, 2013
3. Cyril Donaldson and George H LeCain, Tool Design,TMH
4. Handbook of Fixture Design – ASTME
5. Campbell J. S., Principles of Manufacturing Materials and Processes, Tata McGraw Hill, 1999
6. P R Beeley, Foundry Technology, Elsevier, 2001
7. Richard W. Heine, Carl R. Loper, Philip C. Rosenthal, Principles of Metal Casting,

Tata McGraw-Hill Education, 2001
8. Paul Degarma E and Ronald A. Kosher ,Materials and Processes in Manufacturing, Wiley,20111
9. P. N. Rao,Manufacturing Technology Foundry, Forming and Welding, Tata McGraw-Hill Education,2011
10. HMT Production Technology, 1e McGraw Hill,2001

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Course Plan			
Module	**Contents**	**Hours**	**Semester Examination Marks**
I	Sand Casting – Sand Molds-Types of Molding Sands and Testing	1	15%
	Type of patterns - Pattern Materials	1	
	Cores –Types and applications –Sand Molding Machines	1	
	Gating System – Risering	1	
	Shell Mold Casting – Ceramic Mold Casting	1	
	Investment Casting – Vacuum Casting – Slush Casting	1	
	Pressure Casting – Die Casting – Centrifugal Casting	1	
	Design Considerations based on Various Shapes - Defects in Castings – simple problems in casting	1	
II	Principles of Rolling –Types of rolling mills, Mechanics of Flat Rolling	1	15%
	Roll Force and Power Requirement - Neutral Point	1	
	Hot and Cold Rolling	1	
	Defects in Rolled Plates - Rolling Mills	1	
	Ring Rolling – Thread Rolling	1	
	Applications- Rolling of tubes, wheels, axles and I-beams	1	
FIRST INTERNAL EXAM			
III	Classification of forging – Forging methods – Forging under sticking condition	1	15%
	Precision Forging – Coining – Heading – Piercing	1	
	Die Design:- Preshaping, Design Features, Draft Angles – Die Materials and Lubrication	1	
	Forging Machines – Forging Defects and tests	1	
	Extrusion Process - Hot Extrusion – Cold Extrusion	1	
	Impact Extrusion – Extrusion Defects – Drawing Process, wire drawing process	1	

IV	Principles Location - Degrees of Freedom, 3-2-1 principle of locating	1	15%
	Locating from Planes - Locating from Circular Surfaces	1	
	Concentric Locating - Principles of Clamping	1	
	Types of Clamps - Strap Clamps Slide Clamps - Swing Clamps - Hinge Clamps	1	
	Vacuum Clamping - Magnetic Clamping	1	
SECOND INTERNAL EXAM			
V	Sheet metal characteristics – Typical shearing	1	20%
	Bending Sheet and Plate – Spingback - Bending Force	1	
	Press Brake Forming - Tube Bending	1	
	Stretch Forming - Deep Drawing	1	
	Rubber forming - Spinning Shear Spinning - Tube Spinning	1	
	Definition of Welding - Weldability – Solidification of the Weld Metal	1	
	Heat Affected Zone – correlation of strength of welded joint with structure - Welding Defects	1	
VI	Gas Welding: – Flame Characteristics	1	20%
	Equipment, fluxes and filler rods	1	
	Arc Welding – Applications and Equipment	1	
	Electrodes	1	
	Shielded Metal Arc Welding – Submerged Arc Welding	1	
	GTAW – Plasma Arc Welding	1	
	Ultrasonic Welding – Friction Welding	1	
	Resistance Spot Welding	1	
	Resistance Seam Welding – Stud Welding – Percussion Welding - simple problems in welding	1	
	Brazing:- Filler Metals, Methods - Soldering:- Techniques, Types of Solders and Fluxes	1	
END SEMESTER EXAM			

Question Paper Pattern

Total marks: 100, Time: 3 hrs

The question paper should consist of three parts

Part A

4 questions uniformly covering modules I and II. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B

4 questions uniformly covering modules III and IV. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C

6 questions uniformly covering modules V and VI. Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
KTU
Estd.
2014

Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME230	FLUID MECHANICS AND MACHINES LABORATORY	0-0-3-1	2016

Prerequisite: ME203 Mechanics of fluids

Course Objectives: The main objectives of this course is to demonstrate the applications of theories of basic fluid mechanics and hydraulic machines and to provide a more intuitive and physical understanding of the theory.

Syllabus

Study:

1. Study of flow measuring equipments - water meters, venturi meter, orifice meter, current meter, rotameter
2. Study of gauges - pressure gauge, vacuum gauge, manometers.
3. Study of valves - stop valve, gate valve and foot valve.
4. Study of pumps – Centrifugal, Reciprocating, Rotary, Jet.
5. Study of Turbines - Impulse and reaction types.
6. Study of Hydraulic ram, accumulator etc.

List of Experiments:

1. Determination of coefficient of discharge and calibration of Notches
2. Determination of coefficient of discharge and calibration of Orifice meter
3. Determination of coefficient of discharge and calibration of Venturimeter.
4. Determination of Chezy's constant and Darcy's coefficient on pipe friction apparatus
5. Determination of hydraulic coefficients of orifices
6. Determination of metacentric height and radius of gyration of floating bodies.
7. Experiments on hydraulic ram
8. Reynolds experiment
9. Bernoulli's experiment
10. Experiment on Torque converter
11. Performance test on positive displacement pumps
12. Performance test on centrifugal pumps, determination of operating point and efficiency
13. Performance test on gear pump
14. Performance test on Impulse turbines
15. Performance test on reaction turbines (Francis and Kaplan Turbines)
16. Speed variation test on Impulse turbine
17. Determination of best guide vane opening for Reaction turbine
18. Impact of jet

Note: 12 experiments are mandatory

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

1. Discuss physical basis of Bernoulli's equation, and apply it in flow measurement (orifice, Nozzle and Venturi meter), and to a variety of problems
2. Determine the efficiency and plot the characteristic curves of different types of pumps and turbines.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME232	THERMAL ENGINEERING LABORATORY	0-0-3-1	2016

Prerequisite : Should have registered for ME204 Thermal Engineering

Course Objectives:

1. To study the various types IC engines and their parts
2. To conduct the performance test on IC engines, compressors and blowers
3. To familiarize equipment used for measuring viscosity, flash and fire point and Calorific value of petroleum products

Syllabus

List of experiments:

Study of I.C engines :-

a) Diesel engines - all systems and parts

b) Petrol engines - all systems and parts

Experiments

1. Determination of flash and fire points of petroleum products -flash and fire point apparatus
2. Determination of viscosity of lubricating oil- viscometer
3. Determination of calorific value of solid and liquid fuels- calorimeter
4. Determination of calorific value of and gaseous fuels - calorimeter
5. Performance test on petrol engines with various types of loading systems
6. Performance test on Diesel engines with various types of loading systems
7. Heat Balance test on petrol/Diesel engines
8. Cooling curve of IC engines
9. Valve timing diagram of IC engines
10. Economic speed test on IC engines
11. Retardation test on IC engines
12. Determination volumetric efficiency and Air-fuel ratio of IC engines
13. Morse test on petrol engine
14. Performance test on reciprocating compressor
15. Performance test on rotary compressor/blower
16. Draw velocity profile in a pipe flow using Prandtl -Pitot tube
17. Analysis of automobile exhaust gas and flue gas using exhaust gas analyser

Note: 12 experiments are mandatory

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

1. Determine the efficiency and plot the characteristic curves of different types of Internal Combustion engines, compressors and blowers
2. Conduct experiments for the determination of viscosity, calorific value etc of petroleum products