UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

III SEMESTER

AERONAUTICAL ENGINEERING

SCHEME -2013

III SEMESTER
AERONAUTICAL ENGINEERING (S)

Course No	Name of subject	Credits	Weekly load, hours			C A Marks	Exam Duration Hrs	U E Max Marks	Total Marks
			L	T	D/P				
13.301	Engineering Mathematics-II (ABCEFHMNPRSTU)	4	3	1	-	50	3	100	150
13.302	Humanities (BEFMRSU)	3	3	-	-	50	3	100	150
13.303	Fluid Mechanics(MS)	4	3	1	-	50	3	100	150
13.304	Mechanics of Solids (MNPSU)	4	3	1	-	50	3	100	150
13.305	Metallurgy & Material Science (S)	4	3	1	-	50	3	100	150
13.306	Machine Drawing (S)	5	1	-	4	50	4	100	150
13.307	Production Technology (S)	3	2	1	-	50	3	100	150
13.308	MOS Lab (S)	2	-	-	2	50	3	100	150
	Total	**29**	**18**	**5**	**6**	**400**		**800**	**1200**

13.301 ENGINEERING MATHEMATICS - II (ABCEFHMNPRSTU)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

This course provides students a basic understanding of vector calculus, Fourier series and Fourier transforms which are very useful in many engineering fields. Partial differential equations and its applications are also introduced as a part of this course.

Module – I

Vector differentiation and integration: Scalar and vector functions-differentiation of vector functions-velocity and acceleration - scalar and vector fields - vector differential operator-Gradient-Physical interpretation of gradient - directional derivative – divergence - curl - identities involving ∇ (no proof) - irrotational and solenoidal fields - scalar potential.

Vector integration: Line, surface and volume integrals. Green's theorem in plane. Stoke's theorem and Gauss divergence theorem (no proof).

Module – II

Fourier series: Fourier series of periodic functions. Dirichlet's condition for convergence. Odd and even functions. Half range expansions.

Fourier Transforms: Fourier integral theorem (no proof) –Complex form of Fourier integrals-Fourier integral representation of a function- Fourier transforms – Fourier sine and cosine transforms, inverse Fourier transforms, properties.

Module – III

Partial differential equations: Formation of PDE. Solution by direct integration. Solution of Langrage's Linear equation. Nonlinear equations - Charpit method. Homogeneous PDE with constant coefficients.

Module – IV

Applications of Partial differential equations: Solution by separation of variables. One dimensional Wave and Heat equations (Derivation and solutions by separation of variables). Steady state condition in one dimensional heat equation. Boundary Value problems in one dimensional Wave and Heat Equations.

References:

1. Kreyszig E., *Advanced Engineering Mathematics*, 9/e, Wiley India, 2013.
2. Grewal B. S., *Higher Engineering Mathematics*, 13/e, Khanna Publications, 2012.

3. Ramana B. V., *Higher Engineering Mathematics*, Tata McGraw Hill, 2007.
4. Greenberg M. D., *Advanced Engineering Mathematics*, 2/e, Pearson, 1998.
5. Bali N. P. and M. Goyal, *Engineering Mathematics*, 7/e, Laxmi Publications, India, 2012.
6. Koneru S. R., *Engineering Mathematics*, 2/e, Universities Press (India) Pvt. Ltd., 2012.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

At the end of the course, the students will have the basic concepts of vector analysis, Fourier series, Fourier transforms and Partial differential equations which they can use later to solve problems related to engineering fields.

13. 302 HUMANITIES (BEFMRSU)

Teaching Scheme: 3(L) - 0(T) - 0(P) **Credits**: 3

Course Objectives:

- *To explore the way in which economic forces operate in the Indian Economy.*
- *The subject will cover analysis of sectors, dimensions of growth, investment, inflation and the role of government will also be examined.*
- *The principle aim of this subject is to provide students with some basic techniques of economic analysis to understand the economic processes with particular reference to India.*
- *To give basic concepts of book keeping and accounting*

PART I ECONOMICS (2 periods per week)

Module – I

Definition of Economics –Central Economic Problems – Choice of techniques –Production possibility curve – Opportunity Cost-Micro & Macro Economics

Meaning of Demand – Utility-Marginal Utility and Law of Diminishing Marginal Utility-Law of demand - Determinants of Demand – Changes in Demand – Market Demand—Demand, forecasting-Meaning of supply-Law of Supply- Changes in Supply-- Market Price Determination – Implications of Government Price Fixation

Production function – Law of Variable proportion – Returns to scale – Iso-quants and Isocost line- Least cost combination of inputs – Cost concepts – Private cost and Social Cost -

Short run and Long run cost- cost curves – Revenue – Marginal, Average and Total Revenue-Break even Analysis

Module – II

National Income concepts - GNP – GDP – NNP– Per Capita Income – Measurement of National Income-Output method- Income method and Expenditure method -Sectoral Contribution to GDP– Money-Static and Dynamic Functions of Money-Inflation – causes of inflation – measures to control inflation – Demand Pull inflation – cost push inflation – Effects of Inflation – Deflation.

Global Economic Crisis India's Economic crisis in 1991 – New economic policy – Liberalization – Privatization and Globalization-Multinational Corporations and their impacts on the Indian Economy- Foreign Direct Investment (FDI) Performance of India-Issues and Concerns. Industrial sector in India – Role of Industrialization -Industrial Policy Resolutions-Industry wise analysis – Electronics – Chemical – Automobile – Information Technology.

Environment and Development – Basic Issues – Sustainable Development- Environmental Accounting – Growth versus Environment – The Global Environmental Issues- Poverty- Magnitude of Poverty in India- -Poverty and Environment

PART-II- ACCOUNTANCY (1 Period per week)

Module – III

Book-Keeping and Accountancy- Elements of Double Entry- Book –Keeping-rules for journalizing-Ledger accounts-Cash book- Banking transactions- Trial Balance- Method of Balancing accounts-the journal proper(simple problems).

Final accounts: Preparation of trading and profit and loss Account- Balance sheet (with simple problems) - Introduction to accounting packages (Description only).

References

1. Dewett K. K., *Modern Economic Theory,* S Chand and Co. Ltd., New Delhi, 2002.
2. Todaro M., *Economic Development*, Addison Wesley Longman Ltd., 1994.
3. Sharma M. K., *Business Environment in India,* Commonwealth Publishers, 2011.
4. Mithani D. M., *Money, Banking, International Trade and Public Finance*, Himalaya Publishing House, New Delhi, 2012.
5. Dutt R. and K. P. M. Sundaran*, Indian Economy,* S Chand and Co. Ltd., New Delhi, 2002.
6. Hal R. Varian, *Intermediate Micro Economics,* W W Norton & Co. Inc., 2011
7. Koutsoyiannis A., *Modern Micro-economics,* MacMillan, 2003.
8. Batliboi J. R., *Double Entry Book-Keeping,* Standard Accountancy Publ. Ltd., Bombay, 1989.
9. Chandrasekharan Nair K.G., *A Systematic approach to Accounting*, Chand Books, Trivandrum, 2010.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts. Part I and Part II to be answered in separate answer books.

Part I Economics *(70 marks) – Part I shall consist of 2 parts.*

Part A (20 Marks) - Two short answer questions of 10 marks each, covering entire syllabus. All questions are compulsory. (10x2=20marks)

Part B (50 marks) - Candidates have to answer one full question out of the two from Part I (Module I and Module II). Each question carries 25 marks.

Part II Accountancy *(30 marks)*

Candidates have to answer two full questions out of the three from Part II (Module III). Each question carries 15 marks.

Course outcome:

- *The students will be acquainted with its basic concepts, terminology, principles and assumptions of Economics.*
- *It will help students for optimum or best use of resources of the country*
- *It helps students to use the understanding of Economics of daily life*
- *The students will get acquainted with the basics of book keeping and accounting*

13.303 FLUID MECHANICS (MS)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives :

- *This is an introductory course in the mechanics of fluid motion.*
- *It is designed to establish fundamental knowledge of basic fluid mechanics and address specific topics relevant to simple applications involving fluids*
- *To familiarize students with the relevance of fluid dynamics to many engineering systems.*

Module – I

Fundamental Concepts: Properties of fluid - Density, Specific weight, viscosity, surface tension, capillarity, vapour pressure, bulk modulus, compressibility, (description only)

Newton's law of viscosity, Newtonian and non- Newtonian fluids, real and ideal fluids, incompressible and compressible fluids.

Fluid Statics: Pressure – Pressure at a point in a fluid, Pascal's Law. Absolute and gauge pressures, Measurement of pressure -Piezo meter, manometers, pressure gauges.

Buoyancy and flotation- forces on bodies and surfaces, stability of floating and submerged bodies, Metacentre and metacentric height. (Simple problems based on pressure measurements and pressure forces on curved and plane surfaces)

Module – II

Fluid Kinematics: Eulerian and Lagrangian approaches, classification of fluid flow, 1-D, 2-D and 3-D flow, steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational, irrotational flows, stream lines, path lines, streak lines, stream tubes, velocity and acceleration in fluid, circulation and vorticity, stream function and potential function, Laplace equation, equipotential lines flow nets, uses and limitations,

Fluid Dynamics: Energies in flowing fluid, head, pressure, dynamic, static and total head, Control volume analysis of mass, momentum and energy, Equations of fluid dynamics: Differential equations of mass, energy and momentum (Euler's equation), Navier-Stokes equations (without proof) for rectangular and cylindrical co-ordinates, Bernoulli's equation and its applications: Venturi and Orifice meters, Notches and Weirs (description only for notches and weirs). Velocity measurements: Pitot tube and Pitot-static tube.

Module – III

Pipe flow: Viscous flow: Reynolds experiment to classify laminar and turbulent flows, significance of Reynold's number, critical Reynold's number, shear stress and velocity

distribution in a pipe, law of fluid friction, head loss due to friction, Hagen Poiseuille equation. Turbulent flow: Darcy- Weisbach equation, Chezy's equation Moody's chart, Major and minor energy losses, hydraulic gradient and total energy line, flow through long pipes, pipes in series, pipes in parallel, equivalent pipe, siphon, transmission of power through pipes, efficiency of transmission, Water hammer, Cavitation.

Module – IV

Concept of Boundary Layer: Growth of boundary layer over a flat plate and definition of boundary layer thickness, displacement thickness, momentum thickness and energy thickness, laminar and turbulent boundary layers, laminar sub layer, velocity profile, Von-Korman momentum integral equations for the boundary layers, calculation of drag, separation of boundary and methods of control.

Dimensional analysis: Scope of dimensional analysis - dimensional homogeneity, Buckingham's π theorem method - model testing - similitude- classification of models, various types of forces acting in a fluid flow, Dimensionless numbers, model laws - Froude, Reynold, Weber, Cauchy and Mach. laws –applications and limitations of model testing. *(Only descriptions needed in this section)*

References:

1. Modi P. N. and S. M. Seth, *Hydraulics & Fluid Mechanics*, S.B.H Publishers, New Delhi, 2002.
2. Bansal R. K., *A Textbook of Fluid Mechanics and Hydraulic Machines*, Laxmi Publications, 2005.
3. Streeter V. L., E. B. Wylie and K. W. Bedford*, Fluid Mechanics*, Tata McGraw Hill, Delhi, 2010.
4. Kumar D. S., *Fluid Mechanics and Fluid Power Engineering,* S. K. Kataria & Sons, New Delhi, 1998.
5. Douglas J. F., Fluid Mechanics, 4/e Pearson Education, 2005.
6. Fox R. W. and A. T. McDonald, *Introduction to Fluid dynamics*, 5/e, John Wiley and Sons, 2009.
7. Subramanya K., *Theory and Applications of Fluid Mechanics*, Tata McGraw Hill, 1993.
8. Shames I. H., *Mechanics of Fluids*, McGraw-Hill, 1992.
9. White F.M., *Fluid Mechanics*, 6/e, Tata McGraw Hill, 2008.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

Students successfully completing this course are expected to:

- *Learn the Fluid properties and principles of Fluid statics, kinematics and dynamics.*
- *Calculate pressure variations in accelerating fluids using Euler's and Bernoulli's equations*
- *Conversant with the concepts of flow measurements and flow through pipes*
- *Apply the momentum and energy equations to engineering problems.*
- *Evaluate head loss in pipes and conduits.*
- *Use dimensional analysis to design physical or numerical experiments and to apply dynamic similarity.*

13.304 MECHANICS OF SOLIDS (MNPSU)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

- *To acquaint with the basic concepts of stress and deformation in solids.*
- *To practise the methodologies to analyse stresses and strains in simple structural members and to apply the results in simple design problems.*

Module – I

Concept of stress – normal stress and shear stress, concept of strain, normal strain and shear strain, constitutive relation, Hooke's law, modulus of elasticity, modulus of rigidity, deformation of axially loaded bars, members with varying cross section, principle of superposition, composite bars, thermal stress. Saint-Venant's Principle and stress concentration.

Module – II

Linear strain and lateral strain, Poisson's ratio, volumetric strain, bulk modulus of elasticity, relationship between elastic constants.

Concept of stress and strain tensor, generalised Hooke's law. Definition of plane stress, plane strain and examples. Stress transformation (2D only) principal stress and Mohr's circle, Strain energy due to axial loads- gradually and suddenly applied impact loads.

Module – III

Shear force and bending moment diagrams– cantilever, simply supported and over hanging beams-concentrated and UD loads, Theory of simple bending: bending stress and shear stress distribution-rectangular, circular and I sections. Slope and deflection of beams, load-deflection differential equation, computation of slope and deflection of simply supported and cantilever beams- Macaulay's method.

Module – IV

Torsion of circular shafts-solid and hollow shafts-power transmitted by shafts. Thin cylinders and shells subjected to internal and external pressures – thick cylinders and spherical shells-Lame's equation – compound cylinders. Direct and bending stress – short columns – core of section Crippling load- Euler's equation. Analysis of pin-jointed plane perfect frames by the method of joints.

References :

1. Popov E. P., *Engineering Mechanics of Solids*, Prentice Hall, 2006.
2. Timoshenko S., *Strength of Materials Part I - Elementary Theory & Problems*, CBS Publishers, 2004.
3. Shames I. H. and J. M. Pitarresi*, Introduction to Solid Mechanics*, Prentice Hall, 2000.
4. Prasad I. B., *Strength of Materials*, Khanna Publishers, Delhi, 2009.
5. Bansal R. K., Strength of Materials, Laxmi Publications, New Delhi, 2004.
6. Rattan S. S., *Strength of Materials*, Tata McGraw-Hill, New Delhi, 2008.
7. Junarkar S. B. and Shah H. J., *Mechanics of Structures Vol. I & II,* Charotar Publishing House, 1999.
8. Singh D. K., *Strength of Materials,* Ane Books India, New Delhi, 2008.
9. Jose S. and Kurian S. M., *Mechanics of Solids*, Pentagon, 2012.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

Student would be able to analyse stresses and strains in simple structural members and to apply the results in simple design problems. This subject will lay foundation to study subjects like mechanics of materials, machine design etc.

13.305 METALLURGY AND MATERIAL SCIENCE (S)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

To impart knowledge on engineering materials used for aircraft and various form of the materials, its structures, its applicability in aerospace application.

Module – I

General properties of materials, Requirements of aircraft materials, Testing of aircraft materials, Inspection methods, Application and trends in usage in aircraft structures and engines, Introduction to smart materials and nano-material, Selection of materials for use in aircraft.

Aircraft metal alloys and superalloys: Aluminium alloys, Magnesium alloys, Titanium alloys, Plain carbon and Low carbon Steels, Corrosion and Heat resistant steels, Maraging steels, Copper alloys, Producibility and Surface treatments aspects for each of the above; General introduction to superalloys, Nickel based superalloys, Cobalt based superalloys, and Iron based superalloys, manufacturing processes associated with superalloys, Heat treatment and surface treatment of superalloys.

Module – II

Definition and comparison of composites with conventional monolithic materials, Reinforcing fibers and Matrix materials, Fabrication of composites and quality control aspects, Carbon -Carbon Composites production, properties and applications, inter metallic matrix composites, ablative composites based on polymers, ceramic matrix, metal matrix composites based on aluminium, magnesium, titanium and nickel based composites for engines.

Knowledge and identification of physical characteristics of commonly used polymeric material: plastics and its categories, properties and applications; commonly used ceramic, glass and transparent plastics, properties and applications, adhesives and sealants and their applications in aircraft.

Ablation process, Ablative materials and applications in aerospace, Phenomenon of super conduction, Super conducting materials and applications in aerospace.

Module – III

Solid solutions, phase diagrams, Gibb's phase rule, construction of phase diagram, Lever rule, phase transformation, nucleation and growth.

Steel properties: Iron-carbon equilibrium diagram, micro constituents, transformations in steel, TTT diagram.

Material treatment processes: Heat treatment processes, Chemical treatment of steels, Surface hardening, Quenching media and their characteristics. Heat treatment of Aluminium and its and alloys.

Module – IV

Manufacturing methodology: Powder metallurgy, Manufacturing Process, Compacting, Sintering, Vacuum processing, Properties of Powder processed materials, high energy compaction, HIP, Explosive forming. Metal matrix composites, preparation properties and uses. Fibre reinforced resin plastics.

Corrosion and its prevention: Corrosion, coatings, diffusion in solids, Knowledge of the various methods used for removal of corrosion from common aircraft metals and methods employed to prevent corrosion.

References:

1. Reed Hill R. E., *Physical Metallurgy Principles,* Van Nostrand, 1972.
2. Jacobs J. A. and T. F. Kilduff, *Engineering Materials Technology*, Prentice Hall, 2005.
3. Buhl H., *Advanced Aerospace Material*, Springer, Berlin, 1992.
4. Gupta B., *Aerospace Material Vol. 1, 2, 3 ARDB*, S. Chand & Co, 1996.
5. Parker E. R., *Materials for Missiles and Space*craft, McGraw Hill, 1963.
6. Hill E. T., *The Materials of Aircraft Construction*, Pitman London, 1940.
7. Rajan T. V., C. P. Sharma and A. Sharma, *Heat treatment Principles & Techniques*, PHI Learning, 2011.
8. Raghvan V., *Material Science and Engineering*, PHI Learning, 2011.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After the completion of this course, students will get a complete understanding on engineering materials used for aircraft. It also provides students a feel for how material sciences are applied in engineering practice.

13.306 MACHINE DRAWING (S)

Teaching Scheme: 1(L) - 0(T) - 4(P) **Credits**: 5

Course Objectives :

- *To impart the fundamental concepts of machine drawing and primary knowledge of working drawings.*
- *To develop skill to produce assembly drawings, detailed drawings of machines parts and orthographic drawing of different machine parts.*
- *To develop skill to produce drawings by using any standard CAD software.*

Module – I

a) Joints : Bolted joints using hexagonal, square and stud bolts and nuts : Types of cotters and pins -Sleeve and cotter joints -Strap joint and knuckle joints, Pipe joints : Socket and spigot joints – Flanged hydraulic joints – Union joints, Rivet heads : Types of riveting - Lap and butt joint – Zigzag and chain structure - Boiler joints.

b) Couplings: Types of shaft keys and their proportions: Solid and split muff couplings - Protected and flexible type -Claw coupling -Universal coupling,

Module – II

a) Pulleys: Flat pulleys -V-pulleys - Stepped cone pulleys.

b) Tolerances and Fits -Limits and tolerances of machine parts -Hole system and shaft system of tolerances -Designation of fundamental deviation -Types of fits and their selection -Indication of dimensional tolerances and fits on simple machine parts - Geometrical tolerances - Recommended symbols -Indication of geometrical tolerances on simple machine parts -Surface roughness -Indication of surface finish on drawings - Preparation of shop floor drawings of simple machine parts.

Module – III

Bearings - Solid journal bearings -Bushed bearings - Plummer block and footstep bearings - Types of rolling contact bearings -Conventional representation of ball and roller bearings - Assembly of radial and thrust type rolling contact bearings in housing. (Scaled drawings of machine parts or their assembly showing dimensional tolerance are to be prepared.)

Module – IV

Assembly Drawings: Engine parts and other machine parts – stuffing boxes - cross heads – Eccentrics - Petrol Engine connecting rod - Piston assembly - Screws jacks

Note: *Drawing practical classes have to be conducted by using any standard CAD software and using drawing instruments in alternative weeks (4 Hours)*

preferably for each half of the students. Semester End examination (4 Hours) shall be conducted by using drawing instruments only.

All drawing exercises mentioned above are for class work. Additional exercises where ever necessary may be given as home assignments.

References :

1. Gautam Pohit & Gautam Ghosh, *Machine Drawing with AUTO CAD*, Pearson Education, New Delhi, 2004.
2. N. D. Junnarkar, *Machine Drawing,* Pearson Education, New Delhi, 2007.
3. Bhatt N. D. and V. M. Panchal, *Machine Drawing*, Charotar Publisher, 2002.
4. John K.C., *Machine Drawing*, Jet Publications, Thrissur, 1995.
5. Varghese P. I., *Machine Drawing*, VIP Publishers, Thrissur, 2012.

Course Outcome:

At the end of the course, the students will be able to prepare detailed drawings of machine components and will be familiar with the use of standard CAD software.

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Tests (minimum 2)

40% - Class work. (based on drawings prepared in class and as home assignments)

20% - Regularity in the class

University Examination Pattern:

Examination duration: 4 hours *Maximum Total Marks: 100*

The question paper shall consist of 3 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (20 Marks) – Drawing questions from modules I and II. Candidates have to answer one full question out of the two from each module. Each question carries 10 marks.

Part C (60 Marks) - Drawing questions from modules III and IV. Candidates have to answer one full question out of the two from each module. Each question carries 30 marks.

Course Outcome:

At the end of the course, the students will be able to prepare detailed drawings of machine components and will be familiar with the use of standard CAD software.

13.307 PRODUCTION TECHNOLOGY (S)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objective:

To introduce various types of production processes involving casting, welding, machining, metal forming, power metallurgy etc. used in the manufacture of aircraft components such as piston, crankshaft, engine block, front axle, frame, body etc.

Module – I

Casting: Casting types, procedure to make sand mould, types of core making, moulding tolls, machine moulding, special moulding processes – CO2 moulding; shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting, casting defects.

Welding: Classification of welding processes. Principles of Oxy-acetylene gas welding. A.C metal arc welding, resistance welding, submerged arc welding, tungsten inert gas welding, metal inert gas welding, plasma arc welding, thermit welding, electron beam welding, laser beam welding, defects in welding, soldering and brazing.

Module – II

Machining: General principles (with schematic diagrams only) of working and commonly performed operations in the following machines: Lathe, Shaper, Planer, Horizontal milling machine, Universal drilling machine, Cylindrical grinding machine, Capstan and Turret lathe. Basics of CNC machines. General principles and applications of the following processes: Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining, Electron beam machining and Laser beam machining.

Module – III

Forming and shaping of plastics: Types of plastics, characteristics of the forming and shaping processes, moulding of Thermoplastics. Working principles and typical applications of Injection moulding, plunger and screw machines, Blow moulding, Rotational moulding, Film blowing, extrusion, typical industrial applications. Thermoforming, Processing of Thermosets, working principles and typical applications. Compression moulding and transfer moulding. Bonding of Thermoplastics, Fusion and solvent methods, Induction and Ultrasonic methods

Module – IV

Metal forming and powder metallurgy: Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning. Powder metallurgy, Principal steps involved advantages, disadvantages and limitations of powder metallurgy.

References :

1. Kalpajian S., S. R. Schmid, *Manufacturing Processes for Engineering Materials,* 4/e, Pearson Education, 2007.
2. Jain R. K. and S. C. Gupta, *Production Technology*, Khanna Publishers. 16/e, 2001.
3. *H.M.T. Production Technology – Handbook*, Tata McGraw-Hill, 2000.
4. Lindberg R. A., *Process and Materials of Manufacture*, PHI Learning, 2013.
5. Adithan M. and A. B. Gupta, *Manufacturing Technology*, New Age International, 2012.
6. Khanna O. P., and M. Lal, *A Text Book of Production Technology (Vol II)*, Dhanpat Rai & Sons, 2012.
7. Koren Y., *Computer Control of Manufacturing Systems*, McGraw Hill, 1983.
8. Choudhry S. K. H., *Elements of Work Shop Technology (VoL II)*, Media Promoters and Publishers Pvt. Ltd., 2003.
9. Kundra T. K, P. N. Rao and N. K. Tiwari, *Numerical Control and Computer Aided Manufacturing*, Tata McGraw Hill, 1998.
10. Choudhury H., *Elements of Workshop Technology*, *Vol. I and II*, Media Promoters and Publishers Pvt. Ltd., Mumbai, 2005.
11. Nagendra Parashar B. S. and R. K. Mittal, *Elements of Manufacturing Processes*, Prentice-Hall of India, 2006.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

Students will get an insight into the manufacturing process of various aircraft components.

13.308 MECHANICS OF SOLIDS LAB (S)

Teaching Scheme: 0(L) - 0(T) - 2(P) **Credits**: 2

Course Objective:

- *To provide knowledge on the mechanical behaviour of materials.*
- *To acquaint with the experimental methods to determine the mechanical properties of materials.*

List of Experiments:

1. Determination of Young's modulus of steel using mechanical extensometers
2. Determination of Young's modulus of aluminium using electrical extensometers
3. Determination of fracture strength and fracture pattern of ductile material
4. Spring test – open and closed coiled springs – determination of spring stiffness and modulus of rigidity
5. Determination of modulus of rigidity of wires
6. Hardness tests – Brinell hardness, Rockwell hardness (B S C scales), Rockwell superficial hardness (N & T scales), and Vickers hardness
7. Impact test – Izod and Charpy
8. Bending test on wooden beams
9. Torsion test on mild steel rod
10. Shear test on mild steel rod
11. Verification of Maxwell's Reciprocal theorem & Principle of superposition
12. Southwell plot

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test
40% - Class work and Record
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on the list of experiments prescribed.

80% - Procedure, conducting experiment, results, tabulation and inference

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

This subject will lay foundation to study subjects like mechanics of solids, machine design etc. It also provides students a feel for how various engineering properties of materials are applied in engineering practice.