

**Scheme of Examination:**

One question from Part A: 40 marks

One question from Part B: 40 Marks

Viva voce: 20 Marks

Total: 100 Marks

<b>B. E. MECHANICAL ENGINEERING</b>			
<b>Choice Based Credit System (CBCS) and Outcome Based Education (OBE)</b>			
<b>SEMESTER - VIII</b>			
<b>ENERGY ENGINEERING</b>			
Course Code	<b>18ME81</b>	CIE Marks	40
Teaching Hours /Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03
<b>Course Learning Objectives:</b>			
<ul style="list-style-type: none"> <li>• Understand energy scenario, energy sources and their utilization</li> <li>• Learn about energy conversion methods</li> <li>• Study the principles of renewable energy conversion systems.</li> </ul>			
<b>Module-1</b>			
<b>STEAM GENERATORS</b> Coal and ash handling, Generation of steam using forced circulation, high and supercritical pressures, LaMount, Benson, Velox, Loeffler, Schmidt steam generators, Cooling towers and Ponds, Accessories such as Superheaters, De-superheater, Economizers, Air preheaters.			
<b>Module-2</b>			
<b>Solar Energy:</b> Introduction, Solar radiation at the earth's surface, Solar radiation measurements, Flat plate collectors, Focussing collectors, Solar pond, Solar electric power generation-Solar photovoltaics.			
<b>Biomass Energy:</b> Photosynthesis, photosynthetic oxygen production, energy plantation. Bio Chemical Route: Biogas production from organic wastes by anaerobic fermentation, Bio gas plants-KVIC, Janta, Deenbandu models, factors affecting bio gas generation. Thermal gasification of biomass, updraft and downdraft			
<b>Module-3</b>			
<b>Geothermal Energy:</b> Forms of geothermal energy, Dry steam, wet steam, hot dry rock and magmatic chamber systems.			
<b>Tidal Energy:</b> Tidal power, Site selection, Single basin and double basin systems, Advantages and disadvantages of tidal energy.			
<b>Wind Energy:</b> Wind energy-Advantages and limitations, wind velocity and wind power, Basic components of wind energy conversion systems, horizontal and vertical axis wind mills, coefficient of performance of a wind mill rotor, Applications of wind energy.			
<b>Module-4</b>			
<b>Hydroelectric plants:</b> Advantages & disadvantages of water power, Hydrographs and flow duration curves-numericals, Storage and pondage, General layout of hydel power plants- components such as Penstock, surge tanks, spill way and draft tube and their applications, pumped storage plants, Detailed classification of hydroelectric plants, water hammer.			
<b>Ocean Thermal Energy:</b> Ocean thermal energy conversion, Principle and working of Rankine cycle, Problems associated with OTEC.			
<b>Module-5</b>			
<b>NUCLEAR ENERGY</b> Principles of release of nuclear energy-Fusion and fission reactions. Nuclear fuels used in the reactors, Chain reaction, Moderation, breeding, Multiplication and thermal utilization factors. General components of a nuclear reactor and materials, Brief description-Pressurized water reactor, Boiling water reactor, Sodium graphite reactor, Fast Breeder reactor, Homogeneous graphite reactor and gas cooled reactor, Radiation hazards, Shielding, Nuclear waste, Radioactive waste disposal.			
<b>Course Outcomes:</b> At the end of the course the student will be able to:			
CO1: Understand the construction and working of steam generators and their accessories.			

CO2: Identify renewable energy sources and their utilization.

CO3: Understand principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, nuclear, hydel and tidal.

**Question paper pattern:**

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
<b>Textbook/s</b>				
1	Power Plant Engineering	P. K. Nag	Tata McGraw Hill Education Private Limited, New Delhi	Third Edition, 2012.
2	Power Plant Engineering	Arora and Domkundwar	Dhanpat Rai & Co. (P) Ltd.	Sixth Edition, 2012.
3	Non-conventional Sources of Energy	G.D.Rai	Khanna Publishers, New Delhi	Fifth Edition, 2015.
4	Non-conventional energy resources	B H Khan	McGraw Hill Education	3rd Edition
<b>Reference Books</b>				
1	Power Plant Engineering	R. K. Rajput	Laxmi publication New Delhi	
2	Principles of Energy conversion	A. W. Culp Jr	McGraw Hill	1996
3	Power Plant Technology	M.M. EL-Wakil	McGraw Hill International	1994
4	Solar Energy: principles of Thermal Collection and Storage	S.P. Sukhatme	Tata McGraw-Hill	1984

<b>B. E. MECHANICAL ENGINEERING</b>			
<b>Choice Based Credit System (CBCS) and Outcome Based Education (OBE)</b>			
<b>SEMESTER - VIII</b>			
<b>Professional Elective-4</b>			
<b>CNC MACHINE TOOLS</b>			
Course Code	<b>18ME821</b>	CIE Marks	40
Teaching Hours /Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03
<b>Course Learning Objectives:</b>			
<ul style="list-style-type: none"> <li>• To understand fundamentals of the CNC technology.</li> <li>• To get exposed to constructional features of CNC machine tools.</li> <li>• To know the concepts of CNC machine tool drives and feedback systems.</li> <li>• To understand the programming methods in CNC machines.</li> <li>• To understand the cutting tools used, and work holding devices on CNC machine tools.</li> </ul>			
<b>Module-1</b>			
<b>INTRODUCTION TO CNC MACHINE TOOLS:</b> Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre, grinding machine, EDM, types of control systems, CNC controllers, characteristics, interpolators– Computer Aided Inspection.			
<b>Module-2</b>			
<b>STRUCTURE OF CNC MACHINE TOOL:</b> CNC Machine building, structural details, configuration and design, guide ways – Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion – Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, spindle assembly, torque transmission elements – gears, timing belts, flexible couplings, Bearings.			
<b>Module-3</b>			
<b>DRIVES AND CONTROLS:</b> Spindle drives – DC shunt motor, 3 phase AC induction motor, feed drives –stepper motor, servo principle, DC and AC servomotors, Open loop and closed loop control, Axis measuring system – synchro, synchro-resolver, gratings, moiré fringe gratings, encoders, inductosyn, laser interferometer.			
<b>Module-4</b>			
<b>CNC PROGRAMMING:</b> Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, manual part programming for machining centre and turning centre.			
<b>Computer Aided CNC Part Programming:</b> Need for computer aided part programming, Tools for computer aided part programming, APT, CAD/CAM based part programming for well-known controllers such as Fanuc, Heidenhain, Sinumerik etc., and generation of CNC codes from CAM packages.			
<b>Module-5</b>			
<b>TOOLING AND WORK HOLDING DEVICES:</b> Introduction to cutting tool materials – Carbides, Ceramics, CBN, PCD–inserts classification, qualified, semi qualified and pre-set tooling, tooling system for Machining centre and Turning centre, work holding devices for rotating and fixed work parts, modular fixtures, economics of CNC, maintenance of CNC machines.			
<b>Course Outcomes:</b> At the end of the course the student will be able to:			
CO1: Understand evolution, classification and principles of CNC machine tools.			
CO2: Learn constructional details of CNC machine tools, selection of standard components used for CNC machine tools for accuracy and productivity enhancement.			
CO3: Select drives and positional transducers for CNC machine tools.			
CO4: Apply CNC programming concepts of for two axis turning centers and three axis vertical milling centers to generate programs different components.			

CO5: Generate CNC programs for popular CNC controllers.

CO6: Analyse and select tooling and work holding devices for different components to be machined on CNC machine tools.

**Question paper pattern:**

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
<b>Textbook/s</b>				
1	Mechatronics	HMT	Tata McGraw-Hill Publishing Company Limited, New Delhi	2005
2	Computer Control of Manufacturing systems	Koren Y	McGraw Hill	1986
3	Computer Numerical Control Machines	Radhakrishnan P	New Central Book Agency	2002
<b>Reference Books</b>				
1	CNC Machining Hand Book	James Madison	Industrial Press Inc	1996
2	Programming of CNC Machines	Ken Evans, John Polywka& Stanley Gabrel	Industrial Press Inc, New York	Second Edition 2002
3	CNC Programming Hand book	Peter Smid	Industrial Press Inc	2000
4	CAD/CAM	Rao P.N.	Tata McGraw-Hill Publishing Company Limited	2002
5	Computer Numerical Control	Warren S. Seames	Thomson Delmar	Fourth Edition 2002

<b>B. E. MECHANICAL ENGINEERING</b> <b>Choice Based Credit System (CBCS) and Outcome Based Education (OBE)</b> <b>SEMESTER - VIII</b> <b>Professional Elective-4</b>			
<b>TRIBOLOGY</b>			
Course Code	<b>18ME822</b>	CIE Marks	40
Teaching Hours /Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03
<b>Course Learning Objectives:</b> <ul style="list-style-type: none"> <li>• To educate the students on the importance of friction, the related theories/laws of sliding and rolling friction and the effect of viscosity of lubricants.</li> <li>• To expose the students to the consequences of wear, wear mechanisms, wear theories and analysis of wear problems.</li> <li>• To make the students understand the principles of lubrication, lubrication regimes, theories of hydrodynamic and the advanced lubrication techniques.</li> <li>• To expose the students to the factors influencing the selection of bearing materials for different sliding applications.</li> <li>• To introduce the concepts of surface engineering and its importance in tribology.</li> </ul>			
<b>Module-1</b>			
<b>Introduction to tribology:</b> Historical background, practical importance, and subsequent use in the field. <b>Lubricants:</b> Types and specific field of applications. Properties of lubricants, viscosity, its measurement, effect of temperature and pressure on viscosity, lubrication types, standard grades of lubricants, and selection of lubricants.			
<b>Module-2</b>			
<b>Friction:</b> Origin, friction theories, measurement methods, friction of metals and non-metals. <b>Wear:</b> Classification and mechanisms of wear, delamination theory, debris analysis, testing methods and standards. Related case studies.			
<b>Module-3</b>			
<b>Hydrodynamic journal bearings:</b> Friction forces and power loss in a lightly loaded journal bearing, Petroff's equation, mechanism of pressure development in an oil film, and Reynold's equation in 2D. Introduction to idealized journal bearing, load carrying capacity, condition for equilibrium, Sommerfeld's number and it's significance; partial bearings, end leakages in journal bearing, numerical examples.			
<b>Module-4</b>			
<b>Plane slider bearings with fixed/pivoted shoe:</b> Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a fixed/pivoted shoe bearing, center of pressure, numerical examples. <b>Hydrostatic Lubrication:</b> Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing, numerical examples. Introduction to Hydrostatic journal bearings.			
<b>Module-5</b>			
<b>Bearing Materials:</b> Commonly used bearings materials, and properties of typical bearing materials. Advantages and disadvantages of bearing materials. <b>Introduction to Surface engineering:</b> Concept and scope of surface engineering. <b>Surface modification</b> – transformation hardening, surface melting, thermo chemical processes. <b>Surface Coating</b> – plating, fusion processes, vapor phase processes. Selection of coating for wear and corrosion resistance.			
<b>Course Outcomes:</b> At the end of the course, the student will be able to: CO1: Understand the fundamentals of tribology and associated parameters. CO2: Apply concepts of tribology for the performance analysis and design of components experiencing relative			

<p>motion.</p> <p>CO3: Analyse the requirements and design hydrodynamic journal and plane slider bearings for a given application.</p> <p>CO4: Select proper bearing materials and lubricants for a given tribological application.</p> <p>CO5: Apply the principles of surface engineering for different applications of tribology.</p>				
<p><b>Question paper pattern:</b></p> <ul style="list-style-type: none"> <li>• The question paper will have ten full questions carrying equal marks.</li> <li>• Each full question will be for 20 marks.</li> <li>• There will be two full questions (with a maximum of four sub- questions) from each module.</li> <li>• Each full question will have sub- question covering all the topics under a module.</li> <li>• The students will have to answer five full questions, selecting one full question from each module.</li> </ul>				
Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
<b>Textbook/s</b>				
1	Introduction to Tribology	B. Bhushan	John Wiley & Sons, Inc., New York	2002
2	Engineering Tribology	Prasanta Sahoo	PHI Learning Private Ltd, New Delhi	2011
3	Engineering Tribology	J. A. Williams	Oxford Univ. Press	2005
<b>Reference Books</b>				
1	Introduction to Tribology in bearings	B. C. Majumdar	Wheeler Publishing	
2	Engineering Tribology	G. W. Stachowiak and A. W. Batchelor	Butterworth-Heinemann	1992
3	Friction and Wear of Materials	Ernest Rabinowicz	John Wiley & Sons	1995
4	Basic Lubrication Theory	A. Cameron	Ellis Hardwoods Ltd., UK	
5	Handbook of tribology: materials, coatings and surface treatments	B. Bhushan, B.K. Gupta	McGraw-Hill	1997

<b>B. E. MECHANICAL ENGINEERING</b> <b>Choice Based Credit System (CBCS) and Outcome Based Education (OBE)</b> <b>SEMESTER - VIII</b> <b>Professional Elective-4</b>			
<b>NON-DESTRUCTIVE TESTING AND EVALUATION</b>			
Course Code	<b>18ME823</b>	CIE Marks	40
Teaching Hours /Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03
<b>Course Learning Objectives:</b> <ul style="list-style-type: none"> <li>• To introduce the basic principles, techniques, equipment, applications and limitations of Non-Destructive Testing (NDT) methods such as Visual, Penetrant Testing, Magnetic Particle Testing, Ultrasonic Testing, Radiography, Eddy Current.</li> <li>• To enable selection of appropriate NDT methods.</li> <li>• To identify advantages and limitations of NDT methods</li> <li>• To make aware the developments and future trends in NDT.</li> </ul>			
<b>Module-1</b>			
<b>OVERVIEW OF NDT:</b> NDT Versus Mechanical testing, Overview of the Non-Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT. Visual inspection – Unaided and aided.			
<b>Module-2</b>			
<b>SURFACE NDT METHODS:</b> Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials, magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.			
<b>Module-3</b>			
<b>THERMOGRAPHY AND EDDY CURRENT TESTING (ET):</b> Thermography- Principles, Contact and non -contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.			
<b>Module-4</b>			
<b>ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE):</b> Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique –Principle, AE parameters, Applications.			
<b>Module-5</b>			
<b>RADIOGRAPHY (RT):</b> Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography.			
<b>Course Outcomes:</b> At the end of the course the student will be able to: CO1: Classify various non-destructive testing methods. CO2: Check different metals and alloys by visual inspection method. CO3: Explain and perform non-destructive tests like: Liquid penetrant test, Magnetic particle test, Ultrasonic test, X- ray and Gamma ray radiography, Leak Test, Eddy current test. CO4: Identify defects using relevant NDT methods. CO5: Differentiate various defect types and select the appropriate NDT methods for better evaluation.			

CO6: Document the testing and evaluation of the results.

**Question paper pattern:**

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
<b>Textbook/s</b>				
1	Practical Non-Destructive Testing	Baldev Raj, T.Jayakumar, M.Thavasimuthu	Narosa Publishing House	2009
2	Non-Destructive Testing Techniques	Ravi Prakash	New Age International Publishers	1st revised edition 2010
<b>Reference Books</b>				
1	ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", Volume-17	American Society of Metals,	Metals Park, Ohio, USA,	2000
2	Introduction to Non-destructive testing: a training guide	Paul E Mix,	Wiley	2nd Edition New Jersey, 2005
3	Handbook of Nondestructive evaluation	Charles, J. Hellier	McGraw Hill, New York	2001
ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook, Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing.				



<b>B.E, VIII Semester, Mechanical Engineering</b>			
<b>Choice Based Credit System (CBCS) and Outcome Based Education (OBE)</b>			
<b>(Effective from the academic year 2018-19)</b>			
<b>Professional Elective-IV</b>			
<b>AUTOMOBILE ENGINEERING</b>			
Course Code	<b>18ME824</b>	CIE Marks	40
Teaching Hours /Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03
<b>Course Learning Objectives:</b>			
<ul style="list-style-type: none"> <li>• The layout and arrangement of principal parts of an automobile</li> <li>• The working of transmission and brake systems</li> <li>• The operation and working of steering and suspension systems</li> <li>• To know the Injection system and its advancements</li> <li>• To know the automobile emissions and its effects on environment</li> </ul>			
<b>Module - 1</b>			
<p><b>ENGINE COMPONENTS AND IT'S PRINCIPLE PARTS:</b> Spark Ignition (SI) &amp; Compression Ignition (CI) engines, cylinder – arrangements and their relatives merits, Liners, Piston, connecting rod, crankshaft, valves, valve actuating mechanisms, valve and port timing diagrams, Types of combustion chambers for S.I.Engine and C.I.Engines, methods of a Swirl generation, choice of materials for different engine components, engine positioning. Concept of HCCI engines, hybrid engines, twin spark engine, electric car. <b>COOLING AND LUBRICATION:</b> cooling requirements, types of cooling- thermo siphon system, forced circulation water cooling system, water pump, Radiator, thermostat valves. Significance of lubrication, splash and forced feed system.</p>			
<b>Module - 2</b>			
<p><b>TRANSMISSION SYSTEMS:</b> Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive. <b>BRAKES:</b> Types of brakes, mechanical compressed air, vacuum and hydraulic braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, Disk brakes, drum brakes, Antilock –Braking systems, purpose and operation of antilock-braking system, ABS Hydraulic Unit, Rear-wheel antilock &amp; Numerical</p>			
<b>Module - 3</b>			
<p><b>STEERING AND SUSPENSION SYSTEMS:</b> Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Suspension, Torsion bar suspension systems, leaf spring, coil spring, independent suspension for front wheel and rear wheel, Air suspension system. <b>IGNITION SYSTEM:</b> Battery Ignition system, Magneto Ignition system, electronic Ignition system</p>			
<b>Module - 4</b>			
<p><b>SUPERCHARGERS AND TURBOCHARGERS:</b> Naturally aspirated engines, Forced Induction, Types of superchargers, Turbocharger construction and operation, Intercooler, Turbocharger lag.</p> <p><b>FUELS, FUEL SUPPLY SYSTEMS FOR SI AND CI ENGINES:</b> Conventional fuels, alternative fuels,</p>			

normal and abnormal combustion, cetane and octane numbers, Fuel mixture requirements for SI engines, types of carburetors, C.D.& C.C. carburetors, multi point and single point fuel injection systems, fuel transfer pumps, Fuel filters, fuel injection pumps and injectors. Electronic Injection system, Common Rail Direct Injection System

#### Module - 5

**AUTOMOTIVE EMISSION CONTROL SYSTEMS:** Different air pollutants, formation of photochemical smog and causes. Automotive emission controls, controlling crankcase emissions, controlling evaporative emissions, Cleaning the exhaust gas, Controlling the air-fuel mixture, Controlling the combustion process, Exhaust gas recirculation, Treating the exhaust gas, Air-injection system, Air-aspirator system, Catalytic converter.

**EMISSION STANDARDS:** Euro I, II, III and IV norms, Bharat Stage II, III, IV norms. Motor Vehicle Act

#### Course Outcomes:

- To identify the different parts of an automobile and it's working
- To understand the working of transmission and braking systems
- To comprehend the working of steering and suspension systems
- To learn various types of fuels and injection systems
- To know the cause of automobile emissions, its effects on environment and methods to reduce the emissions.

#### TEXT BOOKS:

1. Automobile engineering, Kirpal Singh, Vol I and II (12th Edition) Standard Publishers 2011
2. Automotive Mechanics, S. Srinivasan, (2nd Edition) Tata McGraw Hill 2003.

#### REFERENCE BOOKS

1. Automotive mechanics, William H Crouse & Donald L Anglin (10th Edition) Tata McGraw Hill Publishing Company Ltd., 2007.
2. Automotive mechanics: Principles and Practices, Joseph Heitner, D Van Nostrand Company, Inc
3. Fundamentals of Automobile Engineering, K.K.Ramalingam, Scitech Publications (India) Pvt. Ltd.
4. Automobile Engineering, R. B. Gupta, SatyaPrakashan,(4th Edition) 1984.

<b>B. E. MECHANICAL ENGINEERING</b> <b>Choice Based Credit System (CBCS) and Outcome Based Education (OBE)</b> <b>SEMESTER - VIII</b> <b>Professional Elective-4</b>			
<b>TOOL DESIGN</b>			
Course Code	<b>18ME825</b>	CIE Marks	40
Teaching Hours /Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03
<b>Course Learning Objectives:</b> <ul style="list-style-type: none"> <li>• To develop capability to design and select single point and multipoint cutting tools for various machining operations.</li> <li>• Exposure to variety of locating and clamping methods available.</li> <li>• To enable the students to design jigs and fixtures for simple components.</li> <li>• To expose the students to the design/selection procedure of press tools and die casting dies.</li> </ul>			
<b>Module-1</b>			
<b>Introduction to tool design:</b> Tooling, requirements of a tool designer, general tool design procedure, tool engineering functions and its importance to enhance productivity and quality. Review of cutting tool materials. Tool angles and signature, Carbide inserts grades - ISO designation and applications, tool holders for turning-ISO designation. Solid type tool, brazed tip tool, throwaway indexable insert types, coated carbides and chip breakers. <b>Design of single point cutting tools:</b> Design of shank dimensions using strength and rigidity considerations for rectangular, square and round cross section and selection of tool geometry.			
<b>Module-2</b>			
<b>Design of Multi Point Cutting Tools:</b> Types of drills, Drill bit design - elements like back taper, web thickness, land width, margin, flute length and cross section and selection of tool geometry. Re-sharpening of drill bit. Tool holders for milling, different tapers used for mounting tool holders in milling, ISO designation. Tool mounting systems. <b>Design of milling cutters:</b> Design of elements like number of teeth and height, circular pitch, body thickness, chamfer width, fillet radius and selection of tool geometry. Profile sharpened and form relieved milling cutters. Re-sharpening of side and face milling cutter and end mill.			
<b>Module-3</b>			
<b>Jigs and Fixtures:</b> Functions and differences between jigs and fixtures, advantages in mass production, design principles, economics of jigs and fixtures. <b>Location:</b> 3-2-1 Principle of location, different types of locating elements. <b>Clamping:</b> Principles of clamping, types of clamping devices, and power clamping. Drill bushes; <b>Drill jigs:</b> Different types, exercises of designing jigs for simple components. <b>Fixture Design:</b> Turning fixtures, milling fixtures, grinding fixtures, fixturing for CNC machining centers, and modular fixtures. Design exercises on fixtures for turning and milling for simple components			
<b>Module-4</b>			
<b>Press tools:</b> Classification and working of power presses. Concept and calculations of press tonnage and shut height of a press, components of a simple die, press tool operation, die accessories, shearing action in punch & die, clearance, shear on punch and die, Centre of pressure, and strip layout. Simple, progressive, compound, combination and inverted dies. Design problems on blanking and piercing dies for simple components. <b>Bending dies –</b> Introduction, bend allowance, spring back, edge bending die design.			
<b>Module-5</b>			
<b>Drawing dies –</b> Single action, double action and triple action dies, factors affecting drawing and drawing die design. Design of drawing dies for simple components.			

**Die casting:** Die casting alloys, terminology- core, cavity, sprue, slug, fixed and movable cores, finger cams, draft, ejector pins and plates, gate, goose nozzle, over-flow, platten, plunger, runner, vent, water-line etc. Types of Dies: Single cavity, multi cavity dies, combination dies, unit dies, advantages and disadvantages of types of dies; finishing, trimming and inspection of die casting components, safety, and modern trends in die casting dies.

**Assignment:**

Course work includes a **ToolDesign project**. Tool design project should enable the students to design a tooling like Jig or a fixture for a simple component, fixture for a simple component on CNC machining centers, design of a simple blanking and piercing die, progressive die, drawing die etc. Any one of these exercises should be given as an assignment. A group of students (maximum number in a group should be 4) should submit assembly drawing and part drawings, completely dimensioned, indicating the necessary manufacturing tolerances, surface finish symbols and geometric tolerances wherever necessary. Tool design project must be completed using appropriate solid modeling software. Computer generated drawings must be submitted. Design calculations must be hand written and should be included in the report. Tool design project should be given due credit in internal assessment.

**Course Outcomes:** At the end of the course, the student will be able to:

- CO1: Select appropriate cutting tools required for producing a component.
- CO2: Understand and interpret cutting tool and tool holder designation systems.
- CO3: Select suitable locating and clamping devices for a given component for various operations.
- CO4: Analyze and design a jig/fixture for a given simple component.
- CO5: Understand various press tools and press tool operations.
- CO6: Classify and explain various die casting and injection moulding dies.

**Question paper pattern:**

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
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<b>Textbook/s</b>				
1	Tool Design	Cyril Donaldson, George H. Lecain, V.C.Goold,	Mc Graw Hill Education	5 <sup>th</sup> edition, 2017
2	Manufacturing technology	P.N.Rao,	Mc Graw Hill Education	4 <sup>th</sup> edition, 2013
<b>Reference Books</b>				
1	Jigs and Fixtures	P.H.Joshi	Mc Graw Hill Education	3 <sup>rd</sup> edition, 2010
2	Fundamentals of Tool Design	John.G. Nee, William Dufraime, John W. Evans, Mark Hill	Society of Manufacturing Engineers	2010
3	Fundamentals of Tool Design	Frank W.Wilson	PHI publications	
4	An introduction to Jig and Tool design	Kempester M.H.A	VIVA Books Pvt.Ltd.	2004
5	Metal cutting and Tool Design	RanganathB.J	Vikas publishing house	

6	Metal cutting theory and practice	V. Arshinov& G. Alekseev	MIR publishers, Moscow	
7	Design and production of metal cutting tools	Rodin	Beekman publishers	
8	Production Technology	HMT	TataMc Graw Hill	2013.

<b>B. E. MECHANICAL ENGINEERING</b> <b>Choice Based Credit System (CBCS) and Outcome Based Education (OBE)</b> <b>SEMESTER - VIII</b> <b>Professional Elective-4</b>			
<b>FRACTURE MECHANICS</b>			
Course Code	<b>18ME826</b>	CIE Marks	40
Teaching Hours /Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03
<b>Course Learning Objectives:</b> <ul style="list-style-type: none"> <li>• To expose the students to the fundamentals of mechanics of fracture of materials.</li> <li>• The students will learn about stress / strain and deformation fields near a crack tip, fracture characterizing parameters like stress intensity factor and J integral and kinetics of fatigue crack growth.</li> <li>• To expose the students to fundamentals of linear elastic fracture mechanics, nonlinear (Elastic-Plastic) fracture mechanics and fatigue crack growth.</li> <li>• Exposure to experimental methods for determining the fracture toughness (for example, ASTM standard procedure for JIC testing).</li> <li>• To learn the mechanism of failure of structures by fatigue crack growth.</li> </ul>			
<b>Module-1</b>			
<b>Fracture mechanics principles:</b> Introduction and historical review, Sources of micro and macro cracks. Stress concentration due to elliptical hole, Strength ideal materials, and Griffith's energy balance approach. Fracture mechanics approach to design, NDT and Various NDT methods used in fracture mechanics, Numerical problems. The Airy stress function. Effect of finite crack size. Elliptical cracks, Numerical problems.			
<b>Module-2</b>			
<b>Plasticity effects:</b> Theory of Plastic deformation, Irwin plastic zone correction. Dugdale's approach. The shape of the plastic zone for plane stress and plane strain cases. The plate thickness effect, numerical problems. Determination of Stress intensity factors and plane strain fracture toughness: Introduction, estimation of stress intensity factors. Experimental method- Plane strain fracture toughness test, The Standard test, size requirements, etc.			
<b>Module-3</b>			
<b>The energy release rate,</b> Criteria for crack growth. The crack resistance(R curve). Compliance. Tearing modulus. Stability. <b>Elastic plastic fracture mechanics:</b> Fracture beyond general yield. The Crack-tip opening displacement. The Use of CTOD criteria. Experimental determination of CTOD. Parameters affecting the critical CTOD.			
<b>Module-4</b>			
<b>J integral:</b> Use of J integral. Limitation of J integral. Experimental determination of J integral and the parameters affecting J integral. <b>Dynamics and crack arrest:</b> Crack speed and kinetic energy. Dynamic stress intensity and elastic energy release rate. Crack branching. Principles of crack arrest. Crack arrest in practice. Dynamic fracture toughness.			
<b>Module-5</b>			
<b>Fatigue crack propagation and applications of fracture mechanics:</b> Crack growth and the stress intensity factor. Factors affecting crack propagation. Variable amplitude service loading, Means to provide fail-safety, Paris law, Required information for fracture mechanics approach.			

**Course Outcomes:** At the end of the course the student will be able to:

CO1: Analyse the effects of crack like defects on the performance of Aerospace, Civil, and Mechanical Engineering structures.

CO2: Apply the concepts of fracture mechanics to select appropriate materials for engineering structures to insure damage tolerance.

CO3: Understand mechanics of crack tip fields and appropriate fracture characterizing parameters like stress intensity factor and J integral or nonlinear energy release rate and how to compute them using various methods.

CO4: Apply the concepts of fracture mechanics to determine critical crack sizes and fatigue crack propagation rates in engineering structures leading to life estimation.

CO5: Understand the status of academic research in field of fracture mechanics.

**Question paper pattern:**

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

SI No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
<b>Textbook/s</b>				
1	Elements of fracture mechanics	Prasanth Kumar	Wheeter publication	1999
2	Fracture Mechanics: Fundamentals and Applications	Anderson	CRC press	3rd Ed., 2005
<b>Reference Books</b>				
1	Introduction to fracture mechanics	Karen Hellan	McGraw Hill	2nd Edition
2	Engineering fracture mechanics	S.A. Meguid	Elsevier Applied Science	1989
3	Fracture of Engineering Brittle Materials	Jayatilaka	Applied Science Publishers	1979
4	Fracture and Fatigue Control in Structures	Rolfe and Barsom	Prentice Hall	1977
5	Engineering Fracture Mechanics	Broek	MartinusNijhoff publishers	1982
6	Advanced Fracture Mechanics	M.F.Kanninen and C.H.Popelar	Oxford press	1985