BACHELOR OF TECHNOLOGY (MECHANICAL ENGINEERING) CREDIT BASED
KURUKSHETRA UNIVERSITY KURUKSHETRA
SCHEME OF STUDIES/EXAMINATION
SEMESTER VII(w.e.f. session 2021-2022)

S. No.	Course No.	Course Name	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	MEO*	Open Elective-I	3:0:0	3	3	75	25	0	100	3
2	MEC-401A	Automation in Manufacturing	3:0:0	3	3	75	25	0	100	3
3	MEC-403LA	Mechanical Engineering Lab-III	0:0:2	2	1	0	40	60	100	3
4	MEC-405LA	Project-III	0:0:10	10	5	0	100	100	200	3
5	MEP*	Program Elective-III	3:0:0	3	3	75	25	0	100	3
6	MEP*	Program Elective -IV	3:0:0	3	3	75	25	0	100	3
7	**MEC-407A	Industrial Training-III	2:0:0	2	-	-	100	-	100	
			Total	**26**	**18**	**300**	**240**	**160**	**700**	

Program Elective-III			Program Elective-IV			Open Electives-I	
Course No.	Course Name		Course No.	Course Name		Course No.	Course Name
MEP-401A	Computer Aided Design		MEP-407A	Mechatronic Systems		MEO-401A	Smart Materials
MEP-403A	Finite Element Analysis		MEP-409A	Industrial Robotics		MEO-405A	Non-Destructive Testing
MEP-405A	Power Plant Engineering		MEP-411A	Solar Energy Analysis		MEO-407A	Manufacturing Cost Estimation
						MEO-409A	Ergonomics
						MEO-411A	Air and Noise Pollution

*** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

****MEC-407A**is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 6th semester and students will be required to get passing marks to qualify.

B. Tech. (7th Semester) Mechanical Engineering							
MEO-405A	**NON-DESTRUCTIVE TESTING**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	The purpose of this course is to make the students understand about different inspection and testing methods of components safely and without damage.						
Course Outcomes							
CO1	Students will be able to learn the fundamental concepts of NDT.						
CO2	Students will be able to describe the different methods of NDE.						
CO3	Students will be able to describe the concept of thermography and eddy current testing.						
CO4	Students will be able to explain the ultrasonic testing and acoustic emissions.						

UNIT-I

Introduction to NDT: NDT vs destructive testing, overview of the don-destructive, Testing methods for the detection of manufacturing defects as well as material characterization, relative merits and limitations, various physical characteristics of materials and their applications in NDT, visual inspection – unaided and aided

UNIT-II

Surface NDE methods: 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.

UNIT–III

Thermography and eddy current testing (ET): Thermography- principles, contact and non-contact inspection methods, techniques for applying liquid crystals, advantages and limitations – 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

UNIT–IV

Ultrasonic testing (UT) and acoustic emission (AE): 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.

Text books:

1. Non-Destructive Testing - Baldev Raj, T.Jayakumar, M.Thavasimuthu Narosa Publishing House.

2. Non-Destructive Testing Techniques - Ravi Prakash, 1st revised edition, New Age International Publishers.

Reference books:

1. ASM Metals Handbook,Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio.
2. 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.
3. Handbook of Nondestructive evaluation by Charles, J. Hellier, McGraw Hill, New York 2001.
4. Introduction to Non-destructive testing: a training guide by Paul E Mix, Wiley, 2nd Edition New Jersey, 2005.

Note: The paper setter will set the paper as per the question paper template provided.

MEC-401A	AUTOMATION IN MANUFACTURING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	The purpose of this course is to impart knowledge of production automation, robotics, flexible manufacturing, CNC programming, material handling and automated storage systems.						
Course Outcomes							
CO1	Students will be able to explain the role automation in manufacturing and robotics in industry.						
CO2	Students will be able to describe the group technology and flexible manufacturing techniques in the automated production line and manufacturing system.						
CO3	Students will be able to explain computer aided process planning and shop floor manufacturing activities.						
CO4	Students will be able to develop CNC programs and understand the concept automated guided vehicle and automated storage system in material handling.						

UNIT-I

Introduction: Production system, automation in production system, manual labour in production system, automation principle and strategies, manufacturing industries and products, manufacturing operations, product facilities, product/ production relationship, basic elements of an automation system, advance automation function, level of automation.

Industrial robotics: Robot anatomy and related attributes, joint and links, common robot configuration, joint drive system, sensors in robotics, robot control system, end effectors, grippers and tools, applications of industrial robots, material handling, processing operation, assembly and inspection, robot programming.

UNIT-II

Group technology and cellular manufacturing: Part families, parts classifications and coding, production flow analysis, cellular Manufacturing- composite part concept, machine cell design, applications of group technology, grouping parts and machines by rank order clustering technique, arranging machines in a G.T. cell.

Flexible manufacturing: Introduction, FMS components, flexibility in manufacturing – machine, product, routing, operation, types of FMS, FMS layouts, FMS planning and control issues, deadlock in FMS, FMS benefits and applications.

UNIT- III

Process planning: Introduction, manual process planning, computer aided process planning – variant, generative, decision logic decision tables, decision trees, Introduction to artificial intelligence.

Shop floor control: Introduction, shop floor control features, major displays, major reports, phases of SFC, order release, order scheduling, order progress, manufacturing control, methodology, applications,shop floor data collections, Types of data collection system, data input techniques, automatic data, collection system.

UNIT- IV

CNC basics and part programming: Introduction, historical, background, basic components of an NC, steps in NC, verifications of numerical control machine tool programs, classification of NC Machine tool, basics of motion control and feedback for NC M/C, NC part programming, part programming methods, modern machining system, automatically programmed tools, DNC, adaptive control.

Automated guided vehicle and storage system: Functions of AGV, types of AGV, safety consideration for AGV, design of AGV; Introduction to storage system, storage system performance, storage location strategies, conventional storage method and equipment, automated storage system, fixed aisle automated storage/ retrieval system, carousel storage systems, analysis of storage system, fixed aisle automated storage/ retrieval systems, carousel storage systems.

Text Books:

1. CAD/CAM/CIM-P. Radhakrishnan, S. Subramanayan and V.Raju, New Age International (P) Ltd., New Delhi.
2. Computer Integrated Manufacturing- Alavudeen and Venkateshwaran, Prentice- Hall of India Pvt. Ltd., New Delhi.

Reference Books:

1. Automation, Production System and Computer Integrated Manufacturing- Mikell P. Groover, Pearson fourth edition.
2. CAD/CAM: Computer Aided Design and Manufacturing-Groover-M.P. and Zimmers E. W.,Prentice Hall International, New Delhi, 1992.

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B. Tech. (7th Semester) Mechanical Engineering								
MEC-403L A	**MECHANICAL ENGINEERING LAB-III**							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total Time**	**Time (Hrs.)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**
Purpose:	To provide practical knowledge in the concerned subject that a student opt from the program electives offered in the curriculum.							

COMPUTER AIDED DESIGN PRACTICALS

Course Outcomes

CO1 Students will be able to draw and design 2D models.

CO 2 Students will be able to draw and design 3D modelling.

CO 3 Students will be able to assemble the parts.

List of experiments:

1To study the 2 dimensional drawing, orthographic views, front view, top view and side view.
2Introduction to Solid Works and working with sketch mode.
3To study the wireframe, surface and solid modelling.
4Working with the tools like Pattern, Copy, Rotate, Move and Mirror etc.
5Working with creating 3D features (Extrude & Revolve).
6Working with the tools like Hole, Round, and Chamfer etc.
7 Createthe part drawing of product 1 using any 3D software.
8Draw the part drawing of product 2 using any 3D software.
9Draw the part drawing of product 3 using any 3D software.
10Make assembly by using any 3D software.

Note: Product 1, 2 and 3 must be based on MEP-401.

FINITE ELEMENT ANALYSIS LAB:

Course Outcomes

CO1 Students will be able to apply the basic theory of elasticity to continuum problems

CO2 Students will be able to formulate Finite Element problems like bar, truss and beam elements for linear static structural analysis

CO3 Students will be able to formulate 2D and axisymmetric finite elements

B. Tech. (7th Semester) Mechanical Engineering								
MEC-405LA	**PROJECT-III**							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total Time**	**Time (Hrs.)**
0	**0**	**10**	**5**	**0**	**100**	**100**	**200**	**3**
Purpose:	To implement the engineering principles and theories into innovative practical projects for solving real world problems.							
Course Outcomes								
CO1	Students will be able to apply the theoretical knowledge into practical/software projects.							
CO2	Students will be able to design new products using latest technologies.							

The project work could be done for the problem statement of an industry or practical project in the institute. The students may also opt for the analysis based software projects with proper validation. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

Note: The maximum number of students in a group should not exceed four.

B. Tech. (7th Semester) Mechanical Engineering							
MEP-401A	**COMPUTER AIDED DESIGN**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To apply the computer's technology in designing.						
Course Outcomes							
CO1	To understand the fundamentals of CAD and analyze the CAD hardware.						
CO2	Students will be able to evaluate the CAD software and various transformation operations.						
CO3	Students will be able to analyze the geometric modeling.						
CO4	Students will be able to create surface modeling and understand the data exchange.						

UNIT-I

Fundamentals of CAD: Introduction, Traditional product cycle, CAD/CAM product cycle, rapid prototypic, design for everything, computer aided design, computer aided engineering, customer relationship management, product lifecycle management,

CAD hardware: Introduction, basic structure of computer, input, storage, processing, output, control, microcomputer, minicomputer, mainframes, supercomputer, input out device, LAN, MAN, WAN.

UNIT-II

CAD Software: Introduction, system software, application software, General CAD process, selection of CAD system, database management system, data structure, database types, function of database management system, advantages of DBMS, database coordinate system.

Geometric transformations: Introduction, 2D transformation, translation, rotation, scaling, homogeneous coordinate relationship, reflection transformation, shear transformation, inverse transformation for translation, rotation, scaling, reflection, shear, composite transformation, examples of composite transformation, geometric transformations in engineering design, solved examples.

UNIT-III

Geometric modeling: Need of geometric modeling, requirements of geometric modeling, wire frame modeling, surface modeling, solid modeling, difference between wireframe, surface and solid modeling, introduction to solid modeling, set theory, representation schemes for solid models, boundary representation, cellular decomposition, feature based modeling, Euler theory, mass property calculation.

Mathematical representation of 2D entity: Introduction, parametric representation, of analytic curves, lines, circle, conic selection, ellipse, parabola, hyperbola, parametric representation of synthetic curve, Hermite cubic spline curve, Bezier curves, B- spline curve, non-uniform rational, B splines, manipulation of curves.

UNIT-IV

Mathematical representation of surface entity: Introduction, surface entities, analytic surface, plane surface, tabulated surface, ruled surface, surface of revolution, sweep surface, synthetic surface, Hermite Bicubic surface, Bazier surface, bilinear surface, coons surface

Data exchange formats: Introduction, CAD/CAM data exchange, neutral file formats, data exchange format, initial graphics exchange specification, standard triangular language, standard for exchange of product data.

Text Books:

1. CAD/CAM – Principle Practice and Manufacturing Management - Chris McMahon and Jimmie Browne, Addison Wesley England, Second Edition, 2000.
2. CAD/CAM Theory and Practice, Mastering CAD/CAM - Ibrahim Zeid, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

Reference Books:

1. Mathematical Elements for Computer Graphics - NC-Rogers, D.F. and Adams, McGraw Hill, NY, 1989
2. CAD/CAM/CIM - P. Radhakrishnan, S. Subramanayan and V.Raju, New Age International (P) Ltd., New Delhi.
3. CAD/CAM: Computer Aided Design and Manufacturing - Groover M.P. and Zimmers E. W., Prentice Hall International, New Delhi, 1992.
4. CAD/CAM/CAE - Chougule N. K, Scitech publications (INDIA) PVT. LTD.

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B. Tech (7th Semester) Mechanical Engineering							
MEP-407A	**MECHATRONIC SYSTEMS**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	The purpose of this course is to provide students with an in-depth knowledge of mechatronics systems. The subject will give knowledge of electronics components to students and assist them to acquire inter disciplinary skills.						
Course Outcomes							
CO1	Students will be able to understand Mechatronics systems and their applications. The students will be able to understand different sensors and transducers as well as able to select the transducers as per applications.						
CO2	Students will be able to describe different types of number systems andBoolean algebra and able toconvert number systems from one system to another. The students will be able to explain pin configuration and architecture of microprocessor.						
CO3	Students will be able to understand the architecture of microcontroller and structure of PLC. The students will also be able to draw the ladder diagram.						
CO4	Students will be able to understand various types of actuator. The students will also be able to explain the working of DC and servo motor.						

UNIT-I

Introduction: Definition of mechatronics, multi-disciplinary scenario, evaluation of mechatronics, objectives, advantages & disadvantages of mechatronics, an overview of mechatronics, microprocessor based controllers, principle of working of automatic camera, automatic washing machine & engine management system.

Review of sensors and transducers: Definition and classification of transducers, definition & classification of sensors, performance terminology, working principle and application of displacement, position & proximity, velocity and motion, force, fluid pressure, liquid flow, liquid level, temperature, light sensors, selection of transducers.

UNIT-II

Digital principles: Introduction, digital number system, range and weight of binary number system, octal and hexadecimal number systems, conversion, BCD number systems, gray code, Boolean algebra, logic states, logic functions, more logic gates, universal gates, exclusive-OR gate, minimization of Boolean expression usingKarnaugh map.

Microprocessor: 8086 CPU architecture: 8086 Block diagram, description of data registers, addressregisters; pointer and index registers, PSW, Queue, BIU and EU, 8086 Pin diagram descriptions, 8086 minimum mode and maximum mode CPU module.

UNIT–III

Micro controller: Introduction of 8051 microcontroller &its block diagram, comparison of microprocessor and microcontroller

PLC: Programmable logic controllers, basic structure, input/output processing, ladder diagram timers, internal relays and counters, shift registers, master and jump controls, data handling, analogue input/output, selection of a PLC.

UNIT–IV

Actuators: Definition, classification of actuators, mechanical actuation systems, types of motion, kinematics chains, cams, gear trains, ratchet and pawl, belt and chain drives, bearings, brief survey of electromechanical actuators, drive requirements for cutting movements, requirements of feed drives, calculation of drive requirements on feed motor shaft.

Motors: DC motors & Control of DC motors, DC &AC servomotors, stepper motors-types, characteristics, advantages, limitations and applications, mechanical aspects of motor selection.

Text books:

1.A Textbook of Mechatronics-R. K Rajput, S. Chand & Company, Edition 2010
2.Mechatronics, W. Bolton – Pearson Education Asia - 2nd Edition, 2011.

Reference books:

1.Mechatronics, HMT Ltd., McGraw Hill Education, 2017
2.Mechatronics Principles, Concepts and Application-Nitaigour and Premchand, Mahilik – Tata McGraw Hill – 2003
3.Mechatronics: An Introduction-Robert H. Bishop, CRC Press, 2015
4.Mechatronics: Integrated Mechanical Electronic System- Ramachandran, Vijayaraghavan, Balasundaran- Wiley Publication, 2008

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B. Tech. (7th Semester) Mechanical Engineering								
MEC-407A	**INDUSTRIAL TRAINING-III**							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**--**	**--**	**100**	**--**	**100**	**--**
Purpose	To provide an industrial exposure to the students and enhance their skills and creative capability for conversion of their innovative ideas into physical reality.							
Course Outcomes								
CO 1	Students will be able to self-improve through continuous professional development and life-long learning.							
CO 2	Students will be able to develop social, cultural, global and environmental responsibility as an engineer.							
CO 3	Students will be able to weigh all the latest changes in technological world.							

Note: MEC-407 is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone for minimum 4 weeks after 6th semester and students will be required to get passing marks to qualify.

The candidate has to submit a training report of his/her work/project/assignment completed in the industry during the training period. The evaluation will be made on the basis of training report submitted and viva-voce/presentation.