KLE DR. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY BELAGAVI

DEPARTMENT OF MECHANICAL ENGINEERING

1. **Course Code and Title** **:** 15ME71, Energy Engineering
2. **Course** **:** Core
3. **Teaching Hours** **:** 40
4. **Type of Course** **:** Theory
5. **Class schedule** **:** 03hours / Week
6. **Marks** **:** IA – 20, Final – 80
7. **Course Assessment Methods** **:** Internal Assessment Tests and University Exam
8. **Text Books:**
    1. B H Khan, Non-conventional energy resources, 3rd Edition, McGraw Hill Education
    2. Principles of Energy conversion, A. W. Culp Jr., McGraw Hill. 1996
9. **Reference Books:**
    1. S. P. Sukhatme, Solar Energy: principles of Thermal Collection and Storage, Tata McGraw-Hill (1984).
    2. C. S. Solanki, "Solar Photovoltaics': Fundamental Applications and Technologies, Prentice Hall of India, 2009.
    3. L. L. Freris, Wind Energy Conversion Systems, Prentice Hall, 1990.
10. **Course learning objectives is to**

1. Understand energy scenario, energy sources and their utilization
2. Learn about energy conversion methods and their analysis Study the principles of renewable energy conversion systems Understand the concept of green energy and zero energy.

11. Topics Covered

Lecture No	Topic	% of Portion	
		Module-wise	Cumulative Percentage
MODULE 1 THERMAL ENERGY CONVERSION SYSTEM:			
The objective: The student will be able to Understand energy scenario, energy sources and their utilization			
1	Review of energy scenario in India, general philosophy and need of Energy	20%	20%
2	Different types of fuels used for steam generation, equipment for burning coal in lump form		
3	Strokers, different types, oil burners, advantages and disadvantages of using pulverized fuel		
4	Equipment for preparation and burning of pulverized coal, unit system and bin system		
5	Pulverized fuel furnaces, cyclone furnace, Coal and ash handling, Generation of steam using forced circulation		
6	High and supercritical pressures. Chimneys: Natural, forced, induced and balanced draft,		
7	Calculations and numerical involving height of chimney to produce a given draft.		
8	Cooling towers and Ponds. Accessories for the Steam generators such as Super heaters, De-superheater		
9	Control of super heaters, Economizers, Air preheaters and re-heaters.		
At the end of the module, the student will be able to: Summarize the basic concepts of thermal energy systems.			
MODULE 2 DIESEL ENGINE POWER SYSTEM AND HYDRO-ELECTRIC ENERGY:			
The objective: The student will be able to Learn about energy conversion methods and their analysis.			
10	Diesel Engine Power System: Applications of Diesel Engines in Power field. Method of starting Diesel engines	20%	40%
11	Layout of diesel power plant.		
12	Hydro-Electric Energy: Hydrographs, flow duration and mass curves, unit hydrograph and numerical		
14	Numerical, Storage and Pondage, pumped storage plants,		
15	Low, medium and high head plants, Penstock, water hammer, surge tanks, gates and valves		
16	General layout of hydel power plants		
At the end of the module, the student will be able to: Identify renewable energy sources and their utilization.			
MODULE 3 SOLAR ENERGY:			
The objective: The student will be able to Study the principles of renewable energy conversion systems			
17	Fundamentals; Solar Radiation; Estimation of solar radiation on		

	horizontal and inclined surfaces;	20%	60%
18	Measurement of solar radiation data, Solar Thermal systems: Introduction;		
19	Basics of thermodynamics and heat transfer; Flat plate collector;		
20	Evacuated Tubular Collector; Solar air collector; solar concentrator; solar distillation		
21	Solar cooker; Solar refrigeration and air conditioning; Thermal energy storage systems,		
22	Solar Photovoltaic systems: Introduction; Solar cell Fundamentals;		
23	Characteristics and classification; Solar cell: Module,		
24	Panel and Array construction; Photovoltaic thermal systems		
At the end of the module, the students will be able to: Understand the basic concepts of solar radiation and analyze the working of solar PV and thermal systems.			
MODULE 4 WIND ENERGY AND TIDAL POWER:			
The objective: The student will be able to learn to know the Injection system and its advancements.			
25	Wind Energy: Properties of wind, availability of wind energy in India,	20%	80%
26	Wind velocity and power from wind; major problems associated with wind power		
27	Wind machines; Types of wind machines and their characteristics, horizontal and vertical axis wind mills		
28	Coefficient of performance of a wind mill rotor (Numerical Examples).		
29	Numerical Examples		
30	Tidal Power: Tides and waves as energy suppliers and their mechanics;		
31	Fundamental characteristics of tidal power		
32	Harnessing tidal energy, limitations		
At the end of the module, the students will be able to: Understand principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, and biogas.			
MODULE 5 BIOMASS ENERGY AND GREEN ENERGY:			
The objective: The student will be able to Understand the concept of green energy and zero energy.			
33	Biomass Energy: Introduction; Photosynthesis Process;	20%	100%
34	Biofuels; Biomass Resources; Biomass conversion technologies		
35	Urban waste to energy conversion; Biomass gasification.		
36	Green Energy: Introduction: Fuel cells: Overview;		
37	Classification of fuel cells; operating principles;		
38	Fuel cell thermodynamics nuclear, ocean, MHD,		
39	Thermoelectric and geothermal energy applications; Origin and their types		
40	Working principles, Zero energy Concepts		
At the end of the module, the students will be able to: Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator			

12. Course Outcomes

At the end of the course, the Students will be able to;

1. Summarize the basic concepts of thermal energy systems,
2. Identify renewable energy sources and their utilization.
3. Understand the basic concepts of solar radiation and analyze the working of solar PV and thermal systems.
4. Understand principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, and biogas.
5. Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator.
6. Identify methods of energy storage for specific applications

13. Person (s) who prepared this description and date of preparation:

Prof. Veeresh M. Kodekal
Assistant Professor

Prof. Satish L. Hulamani
Assistant Professor

August 2018

KLE DR. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY BELAGAVI

DEPARTMENT OF MECHANICAL ENGINEERING

1. **Course Code and Title** **:** 15ME72, Fluid Power Systems
2. **Course** **:** Core
3. **Contact Hours** **:** 50
4. **Type of Course** **:** Theory
5. **Class schedule** **:** 04 hours / Week
6. **Marks** **:** IA – 20, Final – 80
7. **Course Assessment Methods:** Internal Assessment Tests and University Exam
8. **Text Books:**
   1. Fluid power with applications, Anthony Esposito, fifth edition Pearson education, Inc. 2000.
   2. Pneumatics and Hydraulics, Andrew Parr. Jaico Publishing Co. 2000.

9. **References Books:**
   1. Oil Hydraulic Systems – Principles and Maintenance, S. R. Majumdar, Tata Mc Hill Publishing Co., Ltd. 2001.
   2. Pneumatic systems, S. R. Majumdar, Tata Mc Hill Publishing company Ltd. 1995.
   3. Industrial Hydraulics, Pippenger, Hicks, McGraw Hill, New York.

Learning Assignment:

The faculty will allocate one or more of the following experiments from group A and B to group of students (containing not more than four students in a group):

Group A: Experiments on hydraulic trainer:

a. Speed control circuit using metering in and mete ring out technique
b. Regenerative and sequencing circuits.
c. Extend-Retract and Stop system of a linear actuator
d. Rapid Traverse and Feed circuit.

Group B: Experiments on pneumatic trainer:

a. Automatic reciprocating circuit
b. Speed control circuit
c. Pneumatic circuit involving shuttle valve/ quick exhaust valve
d. Electro pneumatic valves and circuit

List of Open Source Software/learning website:

1. Simulink
2. Sim Hydraulics

10. Topics Covered

Lecture No.	Details of topics covered	% of portion	
		Module-wise	Cumulative
Module-1 Introduction to fluid power systems			
1	Pascal's law and problems on Pascal's law	**20**	**40**
2	Continuity equation introduction of units.		
3	Structure of hydraulic control system.		
4	Transmission of power at static and dynamic states		
5	Hydraulic oils, properties, general types of fluids		
6	Sealing devices		
7	Reservoir system		
8	Filters and strainers, problem caused by gases in hydraulic fluids		
9	Wear of moving parts due to solid particle contamination, temperature control		
10	Trouble shooting		
Module-2 Pumps and actuators			
11	The source of hydraulic power: pumps, pumping theory, pump classification	**20**	**40**
12	Gear pumps		
13	Vane pumps		
14	Piston pumps		
15	Pump performance, pump selection, Variable displacement pumps		
16	Accumulators: Types, selection/ design procedure, applications of accumulators.		
17	Types of Intensifiers, Pressure switches /sensor, Temperature switches/sensor, Level sensor.		
18	Linear hydraulic actuators, mechanics of hydraulic cylinder loading, Rotary actuators,		
19	gear motors, vane motors, piston motors		
20	Hydraulic motor performance		

Module-3 **Components and hydraulic circuit design Components**			
21	Classification of control valves	**20**	**60**
22	DCVs – symbolic representation features		
23	PCVs – symbolic representation features		
24	FCVs – symbolic representation features		
25	Control of single and double- acting Hydraulic cylinder		
26	Regenerative circuit, pump unloading circuit		
27	Double pump hydraulic system, counter balance valve application		
28	Hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve		
29	Cylinder synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors		
30	Accumulators and circuits.		
Module-4 Pneumatic power systems			
31	Choice of working medium, characteristic of air	**20**	**80**
32	Control of pneumatic control system, pneumatic actuators		
33	Linear cylinders, types and working , end position cushioning		
34	Seals, mounting arrangements, applications		
35	Rod less cylinder, working, advantages, rotary cylinders, types and applications		
36	Design parameters and selection		
37	Pneumatic cylinders		
38	Design and constructional aspects, poppet valves, slide valves, spool valves, suspended seat type slide valve		
39	Simple pneumatic control : direct and indirect actuation of pneumatic cylinders, use of memory valve		
40	FCVs and speed control of cylinders, supply and exhaust air throttling, use of quick exhaust valve		
Module-5 Pneumatic control circuits			
41	Symbolic representation as per ISO 1219 and ISO 5599	**20**	**100**

42	Signal processing elements: use of logic gates, OR and AND gates, pneumatic applications, practical examples involving such logic gates		
43	Pressure dependent controls, types construction, practical applications		
44	Time dependent controls, principle, construction, practical applications		
45	Coordinated and sequential motion control, motion and control diagrams, signal elimination methods		
46	Cascading method, principle and practical application, examples using cascading method		
47	Electro pneumatic control, principles, signal input and output pilot assisted solenoid control of DCVs		
48	Use of relay and contactors, control of circuitry for simple single cylinder applications		
49	Compressed air, production, compressor, preparation of compressed air, Distribution of compressed air, piping layout		
50	Driers, filters, regulators ,lubricators		

Course Outcomes:

Students will be able

CLO1: To provide an insight into the capabilities of hydraulic and pneumatic fluid power.

CLO2: To understand concepts and relationships surrounding force, pressure, energy and power in fluid power systems.

CLO3: To examine concepts centering on sources of hydraulic power, rotary and linear actuators, distribution systems, hydraulic flow in pipes, and control components in fluid power systems.

CLO4: Exposure to build and interpret hydraulic and pneumatic circuits related to industrial applications.

CLO5: To familiarize with logic controls and trouble shooting

13. Person (s) who prepared this description and date of preparation:

Prof. Shrishail B. Angadi
Associate Professor

Prof. Sachidananda T. G.
Assistant Professor

August 2018

KLE DR. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY BELAGAVI

DEPARTMENT OF MECHANICAL ENGINEERING

1. **Course Code and Title** **:** 15ME73, Control Engineering
2. **Course** **:** Core
3. **Contact Hours** **:** 54
4. **Type of Course** **:** Theory
5. **Class schedule** **:** 03+02 (Theory+ Tutorial) hours / Week
6. **Marks** **:** IA – 20, Final – 80
7. **Course Assessment Methods** **:** Internal Assessment Tests and University Exam
8. **Text Books:**
    1. Modern control engineering: Katsuhiko Ogatta, Pearson Education,2004.
    2. "Control Systems Principles and design ", M. Gopal, TMH,2000
9. **Reference Books:**
    1. "Feedback Control System ", Schaum's series. 2001.
    2. "Control Systems ", I. J. Nagarath and M. Gopal, New age International Publishers, 2002.
    3. "Automatic Control Systems", B. C. Kuo, F. Golnaraghi, John Wiley & sons, 2003.

10. COURSE OBJECTIVES

1. Modelling of mechanical, hydraulic, pneumatic and electrical systems.
2. Representation of system elements by blocks and its reduction
3. Transient and steady state response analysis of a system.
4. Frequency response analysis using polar plot.
5. Frequency response analysis using bode plot.
6. Analysis of system using root locus plots.
7. Different system compensators and variable characteristics of linear systems.

11. Topics Covered

Lecture No	Topic	% of Portion	
		Module-wise	Cumulative
Module 1 – INTRODUCTION			
The objective of this unit is to learn Different types of systems and controllers are dealt			
1	Concept of automatic controls	11%	11%
2	Open loop and closed loop systems ,Difference		
3	Concepts of feedback & requirements of an ideal control system		
4	Types of controllers- Proportional, integral		
5	Proportional		
6	Integral		
7	Proportional Integral Differential		
At the end of the unit, the students are able to:			
1. Define the control systems and its classification.			
2. Distinguish between open loop and closed loop systems.			
3. Define various controllers.			
Module 2- MATHEMATICAL MODELS			
The objective of this unit is to learn • System behaviour is described through mathematical equations. • Conversion of mechanical system to electrical system is done. • Transfer function of various systems are obtained. • The complex block diagrams are reduced to simple to obtain the transfer function. • Control systems represented by signal flow graphs are solved to obtain the transfer function. • Conversion of block diagram to signal flow graphs is done.			
8	Mathematical Models of Mechanical	25 %	36 %
9-10	Transfer function models of electrical systems		
11	DC and AC motors in control systems		
12	Transfer function models of thermal systems		
13-14	Transfer function models of hydraulic systems Transfer function models of pneumatic systems Force voltage analogy & Force current analogy		
15	Direct and inverse analogs for mechanical, thermal and fluid systems.		
16	General representation of a feedback control system, transfer functions, rules of block diagram algebra.		
17	Reduction of block diagrams		
18	Signal flow graphs		
19-20	Mason's gain formula		
At the end of the unit, the students are able to:			
1. Obtain transfer function of mechanical, electrical, thermal, hydraulic systems.			
2. Obtain the conversion of mechanical to electrical systems.			
3. Obtain the transfer functions of control systems by block diagram reduction techniques.			
4. Obtain the transfer functions of control systems by Mason's gain formula.			
Module 3 - TRANSIENT AND STEADY STATE RESPONSE ANALYSIS			
The objective of this unit is to learn			

- System's response to various types of inputs are studied. Stability of the control system is found out by R-H Criteria.
- Nature of variation of the roots of the characteristic equation of the system with the variation in the gain is studied.

21	Steady state analysis for general block dia. for a control system	27 %	63 %
22	First order response to step, ramp and impulse inputs		
23	Second order response to step, ramp and impulse inputs		
24-25	Concepts of time constant and its importance in speed of response.		
26	System stability : Routh's- Hurwitz Criterion		
27-28	Root locus method: Significance of Root locus, angle and magnitude conditions, breakaway points		
29-30	angles of departure and arrival, construction of Root locus using general rules and steps,		
31-33	Lead and Lag compensation		

At the end of the unit, the students are able to:

1. Derive System's response to various types of inputs for different order control systems.
2. Solve the problems on Routh's- Hurwitz Criterion.
3. Obtain the root locus.
4. Obtain the value of Gain.
5. Identify the stability.

Module 4 - Frequency Domain Analysis

The objective of this unit is to

- Understand System's stability is to be found out by using Nyquist criteria for sinusoidal inputs.
- Obtaine the system's stability using bode plots

34	Relationship between time and frequency response, Polar plot,	25 %	88 %
35	Nyquist stability criterion		
36	Stability analysis		
37	Relative stability concepts		
38	Grain margin and phase margin		
39	M&N circles		
40-41	Bode attenuation diagrams		
42-44	Stability analysis using Bode plots		
45-47	Simplified Bode Diagrams		

At the end of the chapter students are able to

1. Obtain polar and Nyquist plots.
2. obtain the stability based on polar and Nyquist plots
3. Obtain gain margin and phase margin from the plots.
4. Obtain the stability of the system.

Module 5 - CONTROL ACTION AND SYSTEM COMPENSATION

The objective of this unit is to learn the compensation techniques, compensation devices to obtain the stability of the system.

48-49	Series and feedback compensation	12 %	100 %
50	Introduction to state concepts		
51	state equation of linear continuous data system		

52	Matrix representation of state equations		
53	controllability and observability		
54	Kalmanand Gilberts test		

At the end of the unit, the students are able to:

1. Identify compensation devices.
2. Distinguish compensation devices.
3. Obtain the state space representation

12. Course Outcomes (COs):

Upon the completion of the course the students will be able to:

CO1: **Recognize** control system and its types , control actions

CO2: **Determine** the system governing equations for physical models(Electrical, Thermal, Mechanical, Electro Mechanical) CO3: Calculate the gain of the system using block diagram and signal flow graph

CO4**: Illustrate** the response of 1st and 2nd order systems

CO5: **Determine** the stability of transfer functions in complex domain and frequency domain

CO6: **Employ** state equations to study the controllability and observability

CO1**: Recognize** control system and its types, control actions

13. Person (s) who prepared this description and date of preparation:

Dr. Subhas F. Patil
Professor and Head

Prof. Niranjan L. Pattar
Assistant Professor

August, 2018

KLE DR. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY BELAGAVI

DEPARTMENT OF MECHANICAL ENGINEERING

1. **Course Code & Title** **:** 15ME742, Tribology
2. **Course** **:** Elective
3. **Contact Hours** **:** 42
4. **Type of Course** **:** Theory
5. **Class schedule** **:** 03 hours / Week
6. **Marks** **:** IA – 20, Final – 80
7. **Course Assessment Methods** **:** Internal Assessment Tests and University Exam
8. **TEXT BOOKS:**
    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

9. **REFERENCE BOOKS:**
    1. "**Introduction to Tribology in bearings**", *B. C. Majumdar*, Wheeler Publishing.
    2. "**Tribology, Friction and Wear of Engineering Material**", *I. M. Hutchings, Edward Arnold*, London, 1992.
    3. "**Engineering Tribology**", *G. W. Stachowiak and A. W. Batchelor*, Butterworth-Heinemann, 1992.
    4. "**Friction and Wear of Materials**", *Ernest Rabinowicz*, John Wiley & sons, 1995.
    5. "**Basic Lubrication Theory**", *A. Cameron*, Ellis Hardwoods Ltd., UK.
    6. "**Handbook of tribology: Materials, Coatings and Surface treatments**", *B. Bhushan, B. K. Gupta*, McGraw-Hill, 1997.

COURSE OBJECTIVES:

CLO1. 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.

CLO2. To expose the students to the consequences of wear, wear mechanisms, wear theories and analysis of wear problems.

CLO3. To make the students understand the principles of lubrication, lubrication regimes, theories of hydrodynamic and the advanced lubrication techniques.

CLO4. To expose the students to the factors influencing the selection of bearing materials for different sliding applications.

CLO5. To introduce the concepts of surface engineering and its importance in tribology.

10. TOPICS COVERED

Lecture No	Topic	% of Portion	
		Class-wise	Cumulative
PART A			
MODULE 1: INTRODUCTION TO TRIBOLOGY AND LUBRICANTS			
1	Historical background, practical importance	3	20
2	Subsequent use in the field	5	
3	Types and specific field of applications	8	
4	Properties of lubricants	10	
5	Viscosity, its measurement	12	
6	Effect of temperature and pressure on viscosity	15	
7	Lubrication types, standard grades of lubricants	18	
8	Selection of lubricants.	20	
MODULE 2: FRICTION AND WEAR			
9	Origin, friction theories	23	40
10	Measurement methods	25	
11	Friction of metals and non-metals	28	
12	Classification and mechanisms of wear	30	
13	Delamination theory	33	
14	Debris analysis	36	
15	Testing methods and standards	38	
16	Related case studies	40	
MODULE 3: HYDRODYNAMIC JOURNAL BEARINGS AND INTRODUCTION TO IDEALIZED JOURNAL BEARING			
17	Friction forces, Power loss in a lightly loaded journal bearing	44	64
18	Petroff's equation	47	
19	Mechanism of pressure development in an oil film	49	
20	Reynold's equation in 2D	51	
21	Reynold's equation in 2D	53	
22	Load carrying capacity, condition for equilibrium	55	
23	Somerfield's number and its significance	58	
24	Partial bearings, end leakages in journal bearing	60	
25	Numerical examples on full journal bearings only	62	
26	Numerical examples on full journal bearings only	64	
MODULE 4: PLANE SLIDER BEARINGS WITH FIXED / PIVOTED SHOE AND HYDROSTATIC LUBRICATION			
27	Pressure distribution, Load carrying capacity	66	80
28	Coefficient of friction, frictional resistance in a Fixed / Pivoted shoe bearing	69	
29	Center of pressure, numerical examples.	71	
30	Introduction to hydrostatic lubrication	74	
31	Hydrostatic step bearings	76	
32	Load carrying capacity	78	

33	Oil flow through the hydrostatic step bearing	80	
34	Numerical examples	82	
MODULE 5: BEARING MATERIALS AND INTRODUCTION TO SURFACE ENGINEERING			
35	Commonly used bearings materials	84	100
36	Properties of typical bearing materials	86	
37	Advantages and disadvantages of bearing materials	88	
38	Concept and scope of surface engineering	90	
39	Surface modification – transformation hardening, surface melting	92	
40	Thermo-chemical processes. Surface Coating – plating	94	
41	Fusion processes, vapor phase processes	96	
42	Selection of coating for wear and corrosion resistance	100	

COURSE OUTCOMES:

After studying this course, students 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 motion.

CO3. Analyze the requirements and design hydrodynamic journal and plane slider bearings for a given application.

CO4. Select proper bearing materials and lubricants for a given tribological application.

CO5. Apply the principles of surface engineering for different applications of tribology.

11. Person (s) who prepared this description and date of preparation:

Prof. M. Sadiq A. Pachapuri
Assistant Professor

August, 2018

KLE DR. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY BELAGAVI

DEPARTMENT OF MECHANICAL ENGINEERING

1. **Course Code and Title** **:** 15ME753, Mechatronics
2. **Course** **:** Elective
3. **Contact Hours** **:** 50
4. **Type of Course** **:** Theory
5. **Class schedule** **:** 03 hours / Week
6. **Marks** **:** IA – 20, Final – 80
7. **Course Assessment Methods** **:** Internal Assessment Tests and University Exam
8. **Text Books:**
    1. Nitaigour Premchand Mahalik, Mechatronics-Principles, Concepts and Applications, Tata McGraw Hill, 1st Edition, 2003 ISBN.No. 0071239243, 9780071239240.
    2. W. Bolton-Pearson Education, Mechatronics – Electronic Control Systems in Mechanicaland Electrical Engineering, 1stEdition, 2005 ISBN No. 81-7758-284-4.
9. **Reference Books:**
    1. Mechatronics by HMT Ltd. – Tata McGrawHill, 1st Edition, 2000. ISBN:9780074636435.
    2. Anthony Esposito, Fluid Power, Pearson Education, 6th Edition, 2011, ISBN No.9789332518544.

10. **Course Objectives**
    1. Understand the evolution and development of Mechatronics as a discipline.
    2. Substantiate the need for interdisciplinary study in technology education.
    3. Understand the applications of microprocessors in various systems and to know the functions of each element
    4. Demonstrate the integration philosophy in view of Mechatronics technology

11. Topics Covered

Lecture No	Topic	% of Portion	
		Module-wise	Cumulative
Module I			
The objective of this unit is to 1. Understand the evolution and development of Mechatronics as a discipline. 2. Substantiate the need for interdisciplinary study in technology education 3. Provide the details of different types of transducers and sensors			
1.	**Introduction**: Definition, Multidisciplinary Scenario	20%	20%
2.	Evolution of Mechatronics		
3.	Design of Mechatronics system		
4.	Objectives, advantages and disadvantages of Mechatronics.		
5.	**Transducers and sensors**: Definition and classification of transducers,		
6.	Difference between transducer and sensor		
7.	Definition and classification of sensors,		
8.	Principle of working and applications of light sensors		
9.	proximity switches		
10.	Hall Effect sensors		
At the end of the unit, the students are able to: 1. Illustrate various components of Mechatronics systems. 2. Identify and select different types of sensors/transducers for particular application			
Module II			
The objective of this unit is to 1. Understand the applications of microprocessors in various systems and to know the functions of each element 2. Demonstrate Intel's 8085A Microprocessor's Architecture			
11.	**Microprocessor & Microcontrollers:** Introduction,	20%	40%
12.	Microprocessor systems, Basic elements of control systems		
13.	Difference between Microprocessor and Microcontrollers.		
14.	**Microprocessor Architecture:** Microprocessor architecture and terminology-CPU, memory and address, ,		
15.	I/O and Peripheral devices		
16.	ALU, Instruction and Program,		
17.	Assembler, Data, Registers, Program Counter		
18.	Flags, Fetch cycle, write cycle, state, and bus interrupts.		
19.	Intel's 8085A Microprocessor.		
20.	Intel's 8085A Microprocessor.		
At the end of the unit, the students are able to: 1. Identify various components of microprocessors and performance specifications			
Module -3			
The objective of this unit is to 1. Imbibe the concepts PLC 2. Demonstrate integration philosophy in view of mechatronics technology			
21.	**Programmable logic controller:** Introduction to PLC's, basic structure,		

22.	Principle of operation,	20%	60%
23.	Programming and concept of ladder diagram,		
24.	Concept of latching & selection of a PLC.		
25.	**Integration**: Introduction & background, Advanced actuators.		
26.	Pneumatic actuators		
27.	Industrial Robot,		
28.	different parts of a Robot-Controller,		
29.	Drive, Arm, End Effectors, Sensor		
30.	Functional requirements of robot		

At the end of the unit, the students are able to:

1. Select an appropriate PLC for required applications

Module-4

The objective of this unit is to

1. Discuss various types mechanical and electrical actuators and their application areas

31.	**Mechanical actuation systems:** Mechanical systems	20%	80%
32.	Types of motion, Cams, Gear trains,		
33.	Ratchet & Pawl, belt and chain drives		
34.	Mechanical aspects of motor selection.		
35.	**Electrical actuation systems:** Electrical systems,		
36.	Mechanical switches,		
37.	Solenoids, Relays,		
38.	DC/AC Motors		
39.	Principle of Stepper Motors		
40.	servomotors.		

At the end of the unit, the students are able to:

1. Elucidate the appropriateness of a particular actuators for particular applications

Module- 5

The objective of this unit is to

1. Comprehend Pneumatic and hydraulic actuation concepts

41.	Pneumatic and hydraulic actuation systems: Actuating systems, Pneumatic	20%	100%
42.	hydraulic systems,		
43.	Classifications of Valves, Pressure relief valves,		
44.	Pressure regulating/reducing valves		
45.	Cylinders and rotary actuators.		
46.	**DCV & FCV:** Principle & construction details, types of sliding spool valve, solenoid operated,		
47.	Symbols of hydraulic elements, components of hydraulic system,		
48.	Functions of various units of hydraulic system.		
49.	Design of simple hydraulic circuits for various applications		
50.	Design of simple hydraulic circuits for various applications		

At the end of the unit, the students are able to:

1. Select an appropriate hydraulic/pneumatic actuators for particular application

12. Course Outcomes (COs):

Upon the completion of the course the students will be able to:

15ME752.1 Illustrate various components of Mechatronics systems.

15ME752.2 Assess various control systems used in automation

15ME752.3 Develop mechanical, hydraulic, pneumatic and electrical control systems**.**

12. Person (s) who prepared this description and date of preparation:

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Associate Professor

Prof. Nagaraj K Kelageri
Assistant Professor

August 2018

KLE DR. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY BELAGAVI

DEPARTMENT OF MECHANICAL ENGINEERING

1. **Course Code & Title** **:** 15MEL76, Design Lab
2. **Course** **:** Core
3. **Contact Hours** **:** 14
4. **Type of Course** **:** Practical's
5. **Class schedule** **:** 03 hours / Week
6. **Marks** **:** IA – 20, Final – 80
7. **Course Assessment Methods** **:** Continuous evaluation of experiments
8. **Text Books:**

1. "Theory of Machines" Rattan S.S., Tata McGraw Hill Pub. Co. Ltd., New Delhi - 1993
2. "Theory of Machines", Sadhu Singh, Pearson Ed. (Singapore) Pvt. Ltd., Indian Branch, New-Delhi, 2002
3. **Theory of Vibration with application** by William T. Thomson, Pearson education Inc., 5th Edition ,2007
4. "**Mechanical Vibrations**:" V. P. Singh, Dhanpat Rai & Company Pvt. Ltd., 3rd edition, 2006
5. Dally and Raley**," Experimental Stress Analysis", McGraw** Hill,1991
6. Sadhu Singh," Experimental **Stress Analysis",** Khanna publishers

9. COURSE OBJECTIVES:

Students are expected-

1. To understand the natural frequency, logarithmic decrement, damping ratio and damping.
2. To understand the balancing of rotating masses.
3. To understand the concept of the critical speed of a rotating shaft.
4. To understand the concept of stress concentration using Photo elasticity.
5. To understand the equilibrium speed, sensitiveness, power and effort of Governor.

10. TOPICS COVERED

Practical No.	Topics Covered	Percentage of portion	
		Practical wise	Cumulative
PART A			
1	Simple Pendulum	3	3
2	Bifilar Suspension	3	6
3	Helical Spring	3	9
4	Single Rotor System	3	12
5	Double Rotor System	3	15
6	Damped Natural Torsional Vibration	3	18
7	Balancing of Rotating Masses	4	22
8	Determination of Critical Speed of a Rotating Shaft (*Demonstration Only*)	2	25
PART B			
9	Determination of Equilibrium Speed, Sensitiveness, Power and Effort of Porter Governor	3	27
10	Determination of Equilibrium Speed, Sensitiveness, Power and Effort of Hartnell Governor	3	30
11	Determination of Pressure Distribution in Journal Bearing	3	33
12	Determination of Principal Stresses and Strains in a Member Subjected to Combined Loading using Strain Rosettes	3	36
13	Calibration of Photo Elastic Model Material by using Circular Disc under Diametrical Compression using Polariscope	3	39
14	Experiment on Gyroscope (*Demonstration Only*)	3	42

11. COURSE OUTCOMES

15MEL76.1 To understand the working principles of machine elements such as Governors, Gyroscopes etc.,

15MEL76.2 To identify forces and couples in rotating mechanical system components.

15MEL76.3 To identify vibrations in machine elements and design appropriate damping methods and to determine the critical speed of a rotating shaft.

15MEL76.4 To measure strain in various machine elements using strain gauges.

15MEL76.5 To determine the minimum film thickness, load carrying capacity, frictional torque and pressure distribution of journal bearing.

15MEL76.6 To determine strain induced in a structural member using the principle of photo-elasticity.

12. Person (s) who prepared this description and date of preparation:

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Prof. Ramesh H. Katti
Assistant Professor
August, 2018

KLE DR. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY BELAGAVI

DEPARTMENT OF MECHANICAL ENGINEERING

1. **Course Code & Title** **:** 15MEL77, Computer Integrated Manufacturing Lab
2. **Course** **:** Core
3. **Contact Hours** **:** 42
4. **Type of Course** **:** Practical
5. **Class schedule** **:** 03 hours / Week
6. **Marks** **:** IA – 20, Final – 80
7. **Course Assessment Methods** **:** Internal Assessment Tests and University Exam
8. **Reference Books:**
    1. Rao "CAD/CAM principles and Applications" TATA Mc Graw Hill Publications 2nd Edition
    2. Mikell P Groover "Automation Production systems and computer Integrated Manufacturing" PHI edition 2002

9. COURSE OBJECTIVES

1. To expose the students to the techniques of CNC programming and cutting tool path generation through CNC simulation software by using G-Codes and M-codes.
2. To educate the students on the usage of CAM packages.
3. To make the students understand the importance of automation in industries through exposure to FMS, Robotics, and Hydraulics and Pneumatics.

10. Topics Covered

Lecture No	Topic	% of Portion	Cumulative
	PART A		
	1. Manual Part programming and Simulation		
	The objective of this unit is to 1. Learn to write the CNC program for the milling and turning 2. Simulate the Milling operations and turning operations in Software 3. Validate the CNC program in the software		
1-15	Write the Manual Part Program for machining part. The Machining operations involved are 1. Face Milling using Face Mill cutter Φ 50mm 2. Pocket Milling using End mill Φ 20mm Generate the Tool Path and simulate the operations in the software.	35%	35%
	Write Manual Part Program for machining the tapped holes on the plate shown in figure. The machining operations involved are 1. Centre drilling 2. Drilling using twist drill Φ8.5mm 3. Tapping the holes using Tap M10x1.5 4. Chamfering the edges of the holes Generate the Tool Path and simulate the operations in the software.		
	Write Manual Part Program for turning the part. The operations involved are 1. Plane turning 2. Chamfering Generate the Tool Path and simulate the operations in the software.		
	Write Manual Part program for the turning the part shown figure. The operations involved are 1. Taper turning 2. Axial hole drilling Generate the tool Path and simulate the operations in software		
	At the end of the unit, the students are able to: 1. Get acquainted with CADEM software 2. Write the part program for the parts involving turning and milling operations		
	2.Create Part, simulate tool path and Generate Part Program		
	The objective of this unit is to 1. Understand the Creating part in software, Simulate the tool path 2. Understand the Generation Part program 3. Optimize spindle power, torque utilization, and cycle time. 4. Generation and printing of shop documents like process and cycle time sheets, tool list, and tool layouts. 5. Cut the part in single block and auto mode and measure the virtual part on screen. 6. Post processing of CNC programs for standard CNC control systems like FANUC, SINUMERIC and MISTUBISHI.		
16-30	Create the Part in CAPSMILL, simulate the tool path and generate the CNC program for the milling of the part. The operations involved are 1. Face Milling 2. Pocket Milling 3. Side Milling 4. Slot milling	35%	70%

	Create the Part in CAPSMILL, simulate the tool path and generate the CNC program for the drilling of the part. The operations involved are 1. Centre drilling 2. Drilling 3. Reaming 4. Tapping 5. Chamfering		
	Create the Part in CAPSTURN, simulate the tool path and generate the CNC program for the turning the part shown figure. The operations involved are 1. Plain turning 2. facing 3. Taper turning 4. Axial hole drilling 5. Grooving 6. Thread cutting		

At the end of the unit, the students are able to:

1. Create the Part in the software
2. Simulate the tool path
3. Generate the part program

Optimize spindle power, torque utilization, and cycle time.

Generate and print shop documents like process and cycle time sheets, tool list, and tool layouts.

Cut the part in single block and auto mode and measure the virtual part on screen.

4. Conduct post processing of CNC programs for standard CNC control systems like FANUC, SINUMERIC and MISTUBISHI.

PART B

Flexible Manufacturing Systems and Robot Programming

The objective of this unit is to Understand the programming of ASRS and Robots

31-36	Programming of Automatic storage and Retrieval system (ASRS) and linear shuttle conveyor interfacing CNC lathe, Milling with loading and unloading arm and ASRS	15%	85%
	Robot programming using teach Pendant and offline programming to perform pick and place, stacking of objects		

At the end of the unit, the students are able to:

1. Discuss about the ASRS and Robot Programming methods

PART C

Pneumatics, Hydraulics and Electro Pneumatics

The objective of this unit is to learn the basics involved in pneumatics, hydraulics and electro pneumatics

37-42	Simulation of Hydraulic circuit	15%	100%

At the end of the unit, the students are able to:

1. Discuss about the basics involved in pneumatics, hydraulics and electro pneumatics

11. Course Outcomes (COs):

Upon the completion of the course the students will be able to:

1. Generate CNC Lathe part program for Turning, Facing, Chamfering, Grooving, Step turning, Taper turning, Circular interpolation etc.
2. Generate CNC Mill Part programming for Point to point motions, Line motions, Circular interpolation, Contour motion, Pocket milling- circular, rectangular, Mirror commands etc.
3. Use Canned Cycles for Drilling, Peck drilling, Boring, Tapping, Turning, Facing, Taper turning Thread cutting etc.
4. Simulate Tool Path for different Machining operations of small components using CNC Lathe & CNC Milling Machine.
5. Use high end CAM packages for machining complex parts; use state of art cutting tools and related cutting parameters; optimize cycle time.
6. Understand & write programs for Robot control; understand the operating principles of hydraulics, pneumatics and electro pneumatic systems. Apply this knowledge to automate & improve efficiency of manufacturing

12. Person (s) who prepared this description and date of preparation:

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August 2018