Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal

New Scheme Based On AICTE Flexible Curricula

Robotics and Mechatronics Engineering VIII- Semester

RM 801	Hydraulic and Pneumatics Engineering	2L-1T-2P	4 Credits

Course Objectives:

1. To gain knowledge on the fundamental aspects of fluid flow physics and properties of fluid flow and selection of hydraulic machinery for relevant applications.
2. To learn various flow measurement techniques

Course Outcomes:

On successful completion of the course, the students will be able to:

CO1: Understand fluid dynamics.

CO2: Learn the principle of operation and components of Hydraulic Actuators and control components.

CO3: Design hydraulic circuits and systems.

CO4: Compare Pneumatic and Electro-Pneumatic Systems.

CO5: Design Pneumatic circuits for Pick and Place applications.

Syllabus:

UNIT I : INTRODUCTION TO HYDRAULICS :

Fluid- Concept and classification of fluid-Newton's law viscosity-Properties of fluid density, Specific gravity, Specific Weight, Specific Volume- Dynamic Viscosity, Kinematic Viscosity, Surface tension, Capillarity, Vapour Pressure, Compressibility-Fluid pressure, Pressure head, Pressure intensity-Concept of absolute vacuum, gauge pressure, atmospheric Pressure-pressure,- Simple and differential manometers, Bourdon pressure gauge.

UNIT II : HYDRAULIC ACTUATORS AND CONTROL COMPONENTS

Hydraulic Actuators: Cylinders, Types and construction, Application, Hydraulic cushioning, Hydraulic motors, Control Components: Direction Control, Flow control and pressure control valves, Types, Construction and Operation, Servo and Proportional valves, Applications, Accessories: Reservoirs, Pressure Switches, Applications, Fluid Power ANSI Symbols, Problems.

UNIT III : HYDRAULIC CIRCUITS AND SYSTEMS

Accumulators, Intensifiers, Industrial hydraulic circuits, Regenerative, Pump Unloading, Double- Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro-hydraulic circuits, Mechanical hydraulic servo systems.

UNIT IV: PNEUMATIC AND ELECTRO-PNEUMATIC SYSTEMS

Properties of air, Perfect Gas Laws, Compressor, Filters, Regulator, Lubricator, Muffler, Air Control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit, Cascade method, Electro Pneumatic System, Elements, Ladder diagram, Problems, Introduction to fluidics and pneumatic logic circuits.

UNIT V : TROUBLESHOOTING AND APPLICATIONS

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press, and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools, Low-cost Automation, Hydraulic and Pneumatic power packs.

REFERENCES

1. Bansal. R.K.,"Fluid Mechanics and Hydraulics Machines", 9th Edition, LaxmiPublicationsPrivate Limited, New Delhi. 2011.
2. R.S.Khurmi, "Fluid Mechanics and Machinery",S.Chand and Company, 2nd Edition, 2007.
3. Hydraulics & Pneumatics – Andrew Parr, Jaico Publishing House New Delhi.
4. Hydraulic and Pneumatic Controls Understanding Made Easy- K.S.Sundaram,- S.chand Company Delhi
5. Oil Hydraulic Systems- Majumdar, S.R. -Tata McGraw-Hill Publication, 3/e, 2013
6. Hydraulic and Pneumatic Controls- Srinivasan, R.- Vijay Nicole Imprints Private Limited, 2/e, 2008
7. Pneumatic And Pneumatics Controls -Understanding Made Easy - K.S.Sundaram,- S.chand Company Delhi
8. Pneumatic Systems - Majumdar, S.R. -Tata McGraw-Hill Publication, 3/e, 2013

List of Experiments / Mini Projects/ Case Studies

1. Study of basics of Hydraulics, Major advantages and disadvantages, Comparison between mechanical, electrical, hydraulic and pneumatic power transmission, Applications of Hydraulics and Pneumatics.

2. Study of pressure measuring instruments in hydraulic and pneumatic systems.

3. Study of oil viscosity measuring instruments in hydraulic and pneumatic system

4.Identify the components and Draw ISO symbols of hydraulic and pneumatic trainers

5. Analyze the performance of Pump and Actuators mounted on hydraulic trainer
6. Analyze the performance of control valves used in hydraulics and pneumatics.
7. Construct and actuate Meter-in, Meter out Hydraulic circuit for the given purpose
8. Develop circuit for simple machine tool applications such as milling machine, shaper machine, grinding machine
9. Construct and actuate speed control Pneumatic circuits for the given pump

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Robotics and Mechatronics Engineering VIII- Semester

RM-802 (a)	Tribology and Maintenance Engineering	3L-1T-0P	4 Credits

Course Objectives:
1.To develop a solution oriented approach by in depth knowledge of Industrial Tribology.
2.To address the underlying concepts, methods and application of Industrial Tribology.

Course Outcomes:
After studying this course, students will be able to;

CO1:Understand fundamental concepts of Contact stresses, residual stress fracture mechanics
CO2: Design friction devices
CO3:Determine wear rate
CO4: Compare SAE,BIS, ASTM, IP, DIN Standards
CO5: Perform Instrumental Tests used in Nano Tribology

Unit-1 : INTRODUCTION OF TRIBOLOGY :
Introduction, history of tribology, early scientific, Studies of - friction, wear, Lubrication. Tribo-Surface preparations and characteristics. ,Surface contacts, Hertz contact stresses, Residual stress, surface fatigue, creep, Stress relaxation, fracture mechanics, elastic, Viscoelastic and plastic behaviour of materials. Choice of materials

UNIT-2 : Friction :

Friction, laws of friction, rolling/sliding friction, Theory of adhesion and abrasion ,Different mechanisms of friction , stick slip characteristics, Interface temperature, thermal analysis, Molecular mechanical theory of friction, Operating conditions and system parameters, Calculations of coefficient of friction, Design of friction devices.

UNIT-3 : Wear :
Different types of wear mechanisms, adhesive, Abrasive impact, percussion erosion, Fretting wear calculations of wear rate, two body/ three body wear, Wear prevention, wear of metal cutting and metal forming tools, Wear mapping of materials, cavitation, Surface fatigue, corrosion, Performance levels classifications and specifications of lubricants

UNIT-4 : Lubrication :
Lubricants and additives, composition and properties of lubricants, Maintenance of oil and emulsions, industrial hygiene aspects, Technical regulations for lubricants. Boundary/ mixed and fluid film lubrication, industrial methods of lubrications, SAE,BIS, ASTM, IP, DIN Standards, Oil testing's, wear and chemistry of lubricants.

UNIT-5 : Nano Tribology :

Instrumental tests,. Bearings, Clutches and brakes, slide units, Dynamic seals, Automobile applications, Machine tools/ press machines applications. Other applications and case studies.

Tutorial topics:

1. Testing equipment of tribology.
2. Various industrial applications of tribology.
3. NEMS and MEMS applications
4. Solid, liquid and mist/ gas lubricants.
5. Surface coatings.
6. Chemical analysis of materials
7. Various simulations
8. AFM/ FFM , SFA, STM, studies.

REFERENCES

1. Fundamentals of Tribology, Basu, SenGupta and Ahuja/PHI
2. Tribology in Industry : Sushil Kumar Srivatsava, S. Chand &Co.
3. Tribology H.G.Phakatkar and R.R.Ghorpade Nirali Publications
4. Tribology – B.C. Majumdar, McGraw Hill Co Ltd.
5. Standard Hand Book of Lubrication Engg., O'Conner and Royle, McGraw Hills C
6. Introduction to Tribology, Halling , Wykeham Publications Ltd.
7. Lubrication, Raymono O. Gunther; Bailey Bros & Swinfan Ltd.
8. Bearing Systems, Principles and Practice, PT Barwll
9. Tribology Hand Book, Michel Ncole

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New Scheme Based On AICTE Flexible Curricula

Robotics and Mechatronics Engineering, VIII-Semester

RM-802 (b)	**Rapid Prototyping & Reverse Engineering**	**3L-1T-0P**	**4 Credits**

Course Objectives:

After learning the course , students will be able to:

CO 1: Use basic 3D CAD package to produce 3D surfaces and solid models.

CO2: Understand the process of Digital prototyping , Virtual prototyping, Rapid Tooling.

CO 3: Identify various types of rapid prototyping machines.

CO4: Know the basic fundamentals of Reverse Engineering and CAD Modeling

CO5: Prepare CAD Model

Syllabus

UNIT 1: RAPID PROTOTYPING

History and Overview of Rapid Prototyping, General Usage of Rapid Prototyping, Data Translations (CAD to Rapid), File Format (STL - Stereolithography), Operation of Rapid Prototyping Machine,

UNIT 2 : VIRTUAL PROTOTYPING

Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping on Product Development –Digital prototyping - Virtual prototyping- Rapid Tooling - Benefits-Applications.

UNIT 3: REVERSE ENGINEERING AND CAD MODELING

Basic concept- Digitization techniques, Model Reconstruction, Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements, geometric modeling techniques: Wireframe, surface and solid modeling, data formats, Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

UNIT 4: LIQUID-BASED AND SOLID-BASED RAPID PROTOTYPING SYSTEMS

Stereolithography (SLA): Apparatus: Principle, per-build process, part-building, post build processes, photopolymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. laminated object manufacturing(LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

UNIT 5: POWDER-BASED RAPID PROTOTYPING SYSTEMS

Selective Laser Sintering(SLS): Principle, process, Indirect and direct SLS- powder structures, modeling of SLS, materials, post-processing, post-curing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping LENS): Processes, materials, products, advantages, limitations and applications– Case Studies.

TEXT BOOKS:

1. Rapid prototyping: Principles and applications, second edition, Chua C.K., Leong K.F., and Lim C.S., World Scientific Publishers, 2003.
2. Rapid prototyping, Andreas Gebhardt, Hanser Gardener Publications, 2003.

REFERENCES:

1. Rapid Prototyping and Engineering applications : A tool box for prototype development, Liou W.Liou, Frank W.Liou, CRC Press, 2007.
2. Rapid Prototyping: Theory and practice, Ali K. Kamrani, Emad Abouel Nasr, Springer, 2006.
3. Rapid Tooling: Technologies and Industrial Applications, Peter D.Hilton, Hilton/Jacobs, Paul F.Jacobs, CRC press, 2000.

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Robotics and Mechatronics Engineering VIII- Semester

RM-802 (c)	Operations Research	3L-1T-0P	4 Credits

Course Outcomes :

After studying this course, students will be able to;

1. Formulate mathematically and solve Linear programming problems
2. Perform sensitivity analysis, compare assignment and transportation problems
3. Apply Game theory
4. Determine problems based on Queuing Theory
5. Apply Monte Carlo simulation in queuing system

Syllabus:

UNIT 1: I Linear programming problems - Mathematical formulation, graphical method of solution, simplex method

UNIT II Duality in linear programming problems, dual simplex method, sensitivity analysis, transportation and assignment problems, Traveling salesman Problem.

UNIT III Game theory Introduction, two-person zero-sum games, some basic terms, the maxmin minimax principle, games without saddle points-Mixed Strategies, graphic solution of 2 * n and m*2 games, dominance property. CPM & PERT- project scheduling, critical path calculations, Crashing.

UNIT IV Queueing theory -basic structure of queuing systems, roles of the Poisson and exponential distributions, classification of queues basic results of M/M/1: FIFO systems, extension to multi-server queues.

UNIT V Simulation: simulation concepts, simulation of a queuing system using event list ,pseudo random numbers, multiplication congruential algorithm, inverse transformation method, basic ideas of Monte-Carlo simulation.

References

• Taha.H.A ,operation Research : An Introduction, McMilan publishing Co., 1982. 7 th ed.

• Ravindran A, Philips D.T & Solbery.J.J, Operations Research: Principles and practice, John Wiley & Sons, New York, 1987.

• Frank S. Budnick, Dennis Mcleavey and Richard Mojena, Principles of Operations Research for Management. All India Traveler Book seller, Delhi.

• Gillet.B.E., Introduction to Operations Research - A Computer oriented algorithmic approach, McGraw Hill, 1987.

• Joseph.G.Ecker & Michael Kupper Schimd, Introduction to operations Research, John Wiley & Sons, 1988.

• Hillier.F.S & Liberman.G.J, operation Research, Second Edition, Holden Day Inc, 1974.

• Heera and Gupta,Operation Research

• Kanti Swarup, Gupta.P.K. & Man Mohan, operations Research, S.Chand & Sons.

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Robotics and Mechatronics Engineering VIII- Semester

RM-803 (a)	IPR (Intellectual Property Rights)	3L-0T-0P	3 Credits

Course Outcomes:

After studying this course, students will be able to**;**

1. Aware of their rights for the protection of their invention done in their project work.
2. Know the registration process in our country and foreign countries of their invention, designs and thesis or theory written by them during their project work and for this they must have knowledge of patents, copy right, trademarks, designs and information Technology Act.
3. Identify the different types of IPRs.
4. Know about the registration of Trade Marks, Infringement & Remedies, Digital signature and Electronic Signature. Cybercrimes.
5. Understand about legal provisions in E-Commerce, E-Governance

Syllabus

UNIT 1: INTRODUCTION TO IPR

Meaning of property, Origin, Nature, Meaning of Intellectual Property Rights – 2 hours Introduction to TRIPS and WTO. Kinds of Intellectual property rights—Copy Right, Patent, Trade Mark, Trade Secret and trade dress, Design, Layout Design, Geographical Indication, Plant Varieties and Traditional Knowledge.

UNIT 2 PATENT RIGHTS AND COPY RIGHTS

Origin, Meaning of Patent, Types, Inventions which are not patentable, Registration Procedure, Rights and Duties of Patentee, Assignment and licence , Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties. – 6 hours COPY RIGHT— Origin, Definition &Types of Copy Right, Registration procedure, Assignment & licence, Terms of Copy Right, Piracy, Infringement, Remedies, Copy rights with special reference to software.

UNIT 3 TRADE MARKS

Origin, Meaning & Nature of Trade Marks, Types, Registration of Trade Marks, Infringement and remedies, Offences relating to Trade Marks, Passing Off, Penalties. Domain Names on cyber space

UNIT 4 DESIGN

Meaning, Definition, Object, Registration of Design, Cancellation of Registration, International convention on design, functions of Design. Semiconductor Integrated circuits and layout design Act-2000.

UNIT 5 BASIC TENENTS OF INFORMATION TECHNOLOGY ACT-2000

IT Act - Introduction E-Commerce and legal provisions E-Governance and legal provisions Digital signature and Electronic Signature. Cybercrimes,

References:

1. Intellectual Property Rights and the Law, Gogia Law Agency, by Dr. G.B. Reddy

2. Law relating to Intellectual Property, Universal Law Publishing Co, by Dr. B.L.Wadehra

3. IPR by P. Narayanan 4. Law of Intellectual Property, Asian Law House, Dr.S.R. Myneni.

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Robotics and Mechatronics Engineering VIII-Semester

RM-803 (b)	Block Chain Technologies	3L-0T-0P	3 Credits

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Understand Nakamoto's concept with Block chain based crypto currency and Technologies Borrowed in Block chain
CO2: Know the concept of Basic Distributed Computing & Crypto primitives
CO3**:** Explain the philosophy of Bit coin block chain, Challenges and solutions
CO4: Writing smart contracts using Solidity & JavaScript
CO5: Understand the fundamentals of Privacy, Security issues in Block Chain

Syllabus:

UNIT 1: Introduction

Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Nakamoto's concept with Blockchain based cryptocurrency, Technologies Borrowed in Blockchain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash etc.

UNIT 2: **Basic Distributed Computing & Crypto primitives:**

Atomic Broadcast, Consensus, Byzantine Models of fault tolerance, Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems

UNIT 3 Bitcoin basics

Bitcoin blockchain, Challenges and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use

UNIT 4. Ethereum basics

Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts, Writing smart contracts using Solidity & JavaScript

UNIT 5. Privacy, Security issues in Block Chain

Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains: Sybil attacks, selfish mining, 51% attacks advent of algorand; Sharding based consensus algorithms to prevent these attacks

Case Studies: Block chain in Financial Service, Supply Chain Management and Government Service

TEXT / REFERENCE BOOKS

1. Mark Gates, “Block chain: Ultimate guide to understanding block chain, bit coin, crypto currencies, smart contracts and the future of money”, Wise Fox Publishing and Mark Gates 2017.

2. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, “Hands-On Block chain with Hyper ledger: Building decentralized applications with Hyperledger Fabric and Composer”, 2018.

3. Bahga, Vijay Madisetti, “Block chain Applications: A Hands-On Approach”, Arshdeep Bahga, Vijay Madisetti publishers 2017

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RM-803 (c)	ERP and Management Information System	3L-0T-0P	3 Credits

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Course Outcomes:

The students will understand the MIS concepts its applications, challenges in implementation of ERP system, ERP System Implementation options, and functional modules of ERP

Syllabus

Unit-I: Introduction MIS importance, definition, nature and scope of MIS, Structure and Classification of MIS, Information and Systems Concept, Types of Information, Information systems for competitive advantage.

Unit-II: Business Applications of Information Systems E-Commerce: E-commerce features & Business Models - Decision Support Systems - Business Process Reengineering - Business Intelligence and Knowledge Management System.

Unit-III: Management of Information Systems Information system planning, system acquisition, systems implementation, evaluation & maintenance of IS, IS Security and Control. Global perspective on cybercrime - Cybercrime era.

Unit-IV: Introduction to ERP ERP System: Overview of ERP Systems, Business benefits of ERP, Vendor Analysis, Challenges of implementing ERP Systems - ERP Maintenance - Emerging Trends in ERP

Unit-V: ERP - Modules Modules: Business Modules in an ERP Package - Manufacturing, Human Resources, Plant Maintenance, Materials Management, and Supply chain Management (SCM), Sales and Distribution. Case Study on Banking Sector

REFERENCES:

1. D P Goyal, Management Information Systems–Managerial Perspective, MacMillan.
2. Laudon & Laudon, Management Information Systems, Pearson. Jawadekar, MIS Text and Cases, TMH.
3. Mary Sumner ―Enterprise Resource Planning‖ Pearson.
4. Ellen Monk ―Enterprise Resource Planning‖ Cengage.
5. Goyal ―Enterprise Resource Planning‖ TMH.

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Robotics and Mechatronics Engineering VIII-Semester

RM-804	**Mechatronics and System Automation Laboratory**	**0L-0T-6P**	**3 Credits**

Suggested List of Experiments

1. Mechatronic system design – robots transporting small loads
2. Strong background in designing and manufacturing of telemetry measurement system using sensor
3. Smart home: Mechatronic system monitoring and “averted” moisture residence for seasonal use
4. Designing educational laboratory exercises for use of PLC
5. Algorithms and techniques for microcomputers to solve problems of classical and modern control.
6. Algorithms and techniques for signal analysis-systems.
7. Application of microcomputers in industrial control and production systems.
8. Strong background in Computer Graphics and CAD / CAM

Evaluation: Evaluation will be continuous and integral part of the class as well as through external assessment (Viva/voce)

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Robotics and Mechatronics Engineering VIII-Semester

RM-805	Major Project -II	0L-0T-8P	3 Credits

Objectives of the course Major Project II:

- To provide students with a comprehensive experience for applying the knowledge gained so far by studying various courses.
- To develop an inquiring aptitude and build confidence among students by working on solutions of small industrial problems.
- To give students an opportunity to do some thing creative and to assimilate real life work situation in institution.
- To adapt students for latest development and to handle independently new situations.
- To develop good expressions power and presentation abilities in students.

The focus of the Major Project II (which may be extension of Major Project I or New topic of project) is on preparing a working system or some design or understanding of a complex system using system analysis tools and submit it the same in the form of a write up i.e. detail project report. The student should select some real life problems for their project and maintain proper documentation of different stages of project such as need analysis market analysis, concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan. Each student is required to prepare a project report and present the same at the final examination with a demonstration of the working system (if any)

Working schedule:

The faculty and students should work according to following schedule: Each student undertakes substantial and individual project in an approved area of the subject and supervised by a faculty of the department. In special case, if project is huge, then maximum 03 students may be permitted to work together as a team to do the same. The student must submit outline and action plan for the project execution (time schedule) and the same be approved by the concerned faculty and Head of department.

Project guide should motivate students to develop some Innovative working models in the emerging area Robotics and Automation, Advanced Automotives, Aero modelling, Renewable

Energy based systems, Mechatronics, Robotic systems, Advanced Manufacturing Technology based systems etc. which can contribute to the society.

Evaluation: There will be both external and internal evaluation of project carried out by each student.
