RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Robotics & Mechatronics, VI-Semester

RM 601- Dynamics of Machine

Course Outcomes:

After completion of the course, students will be able to;

1. Derive displacement ,velocity and acceleration of piston and draw turning moment diagram of different Engines and solve related problems.
2. Analyse flywheel and Governors and also classify different types of Governors
3. Understand the working principle of different types of Governors and their suitable applications
4. Solve problems based on balancing of reciprocating masses and rotary masses.
5. Understand the fundamentals used in Robot Dynamics and apply them in designing of Robots.
6.

Syllabus:

Unit 1: Dynamics of Engine Mechanisms: Displacement, velocity and acceleration of piston; turning moment on crankshaft, turning moment diagram; fluctuation of crankshaft speed, analysis of flywheel.

Unit 2: Governor Mechanisms: Types of governors, characteristics of centrifugal governors, gravity and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors.

Unit 3: Balancing of Reciprocating Masses ; Primary and Secondary Unbalanced Forces of Reciprocating Masses, Partial Balancing of Unbalanced Primary Force in a Reciprocating Engine, Partial Balancing of Locomotives, Variation of Tractive Force, Swaying Couple, . Hammer Blow. Balancing of coupled locomotives.

Unit 4 : Balancing of Rotating Masses: Balancing of single rotating mass by a single mass rotating in the same plane, Balancing of single rotating masses by a two masses rotating in different planes, Balancing of several masses rotating in same plane, Balancing of several masses rotating in different planes.

Unit 5: Robot Dynamics: Dynamics of open chains; Lagrangian formulation of dynamics, centripetal and Coriolis forces, robot mass matrix, dynamics of a rigid body, and Newton-Euler inverse dynamics for an open-chain robot. Trajectory Generation; Point-to-point "straight-line" trajectories and polynomial trajectories passing through via points.

REFERENCES

1.Ambekar, AG; Mechanism and Machine Theory; PHI

2.Rattan SS; Theory of machines; TMH

3.Bevan; Theory of Machines;

4.Ghosh and Mallik; Theory of Mechanisms and Machines; Affiliated East-West Press, Delhi

5.Norton RL; kinematics and dynamics of machinery; TMH

6.Balaney; Theory of Machines

7.Khurmi E.S ;Theory of Machines, S Chand.

8. M. Vidyasagar Mark W Spong; Robot Dynamics and Control , Wiley

9. Reza N. Jazar ;Theory of Applied Robotics Kinematics Dynamics and Control, 2nd Edition , Springer

List of Experiments (Suggested)

1. Study of inertia forces in reciprocating parts and analysis of flywheel.
2. Study of various types of Governor.
3. Experimental investigation of the Characteristics of various types of Governor
4. To study the balancing of rotating masses lie in same and different planes
5. To study balancing of reciprocating masses.
6. Virtual Experiments using Robo Analyzer such as (i) Introduction to Robo Analyzer (ii) Virtual Models of Industrial Robots (iii) Workspace Analysis of a 6 axis robo (iv) Inverse and Forward dynamics of robots (v) Creating robot joint trajectories (vi) Writing a welding profile using a virtual robot.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Robotics & Mechatronics, VI-Semester

RM 602- Non Conventional Machining Processes

Course Outcomes:

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

1: Understand and compare traditional and non-traditional machining process and recognize the need for Non- traditional machining process.

2: Understand the constructional features, performance parameters, process characteristics, applications, advantages and limitations of USM, AJM and WJM.

3: Identify the need of Chemical and electro-chemical machining process along with the constructional features, process parameters, process characteristics, applications, advantages and limitations.

4: Understand the constructional feature of the equipment, process parameters, process characteristics, applications, advantages and limitations EDM & PAM.

5: Understand the LBM equipment, LBM parameters, and characteristics. EBM equipment and mechanism of metal removal, applications, advantages and limitations LBM & EBM

Syllabus:

Unit 1 : Introduction to Non-Traditional Machining; Need for Non-traditional machining process, Comparison between traditional and non-traditional machining, general classification Non-traditional machining processes, classification based on nature of energy employed in machining, selection of non-traditional machining processes, Specific advantages, limitations and applications of non-traditional machining processes.

Unit 2: Ultrasonic Machining (USM) and Abrasive Jet Machining (AJM):

Ultrasonic Machining (USM) ; Introduction, Equipment and process of material removal, Effect of process parameters: Effect of amplitude and frequency, Effect of abrasive grain diameter, effect of slurry, tool & work material. Process characteristics: Material removal rate, tool wear, accuracy, surface finish, applications, advantages & limitations of USM.

Abrasive Jet Machining (AJM ; Introduction, Equipment and process of material removal, process variables: carrier gas, type of abrasive, work material, stand-off distance (SOD).

Process characteristics-Material removal rate, Nozzle wear, accuracy & surface finish. Applications, advantages & limitations of AJM.

Unit 3: Electrochemical Machining (ECM)

Introduction, Principle of electro chemical machining, ECM equipment, elements of ECM operation, Chemistry of ECM. ECM Process characteristics: Material removal rate, accuracy, surface finish. Process parameters: Current density, Tool feed rate, Gap between tool & work piece, velocity of electrolyte flow, type of electrolyte, its concentration temperature, and choice of electrolytes. ECM Tooling: ECM tooling technique & example, Tool & insulation materials. Applications of ECM: Electrochemical grinding and electrochemical honing process. Advantages, disadvantages and application of ECG, ECH.

Unit 4 :Electrical Discharge Machining (EDM) and Plasma Arc Machining (PAM):

Electrical Discharge Machining (EDM) ; Introduction, mechanism of metal removal, EDM equipment: spark erosion generator (relaxation type), dielectric medium-its functions & desirable properties, electrode feed control system. Flushing types; pressure flushing, suction flushing, side flushing, pulsed flushing. EDM process parameters: Spark frequency, current & spark gap, surface finish, Heat Affected Zone. Advantages, limitations & applications of EDM, Electrical discharge grinding, Traveling wire EDM.

Plasma Arc Machining (PAM): Introduction, non-thermal generation of plasma, equipment mechanism of metal removal, Plasma torch, process parameters, process characteristics. Safety precautions. Safety precautions, applications, advantages and limitations.

Unit 5 : Laser Beam Machining (LBM) and Electron Beam Machining (EBM):

Laser Beam Machining (LBM) ; Introduction, generation of LASER, Equipment and mechanism of metal removal, LBM parameters and characteristics, Applications, Advantages & limitations.

Electron Beam Machining (EBM): Introduction, Principle, equipment and mechanism of metal removal, applications, advantages and limitations.

References

1. P.C Pandey and H S Shah ; Modern Machining Process , McGraw Hill Education India Pvt. Ltd
2. V.K.Jain , Advanced Machining Processes, Allied Publishers
3. P.K.Mishra Advanced Machining Processes, Paradise Books Publisher
4. Jagdeesha T Non conventional Machining Processes, Wiley India

Suggested List of Experiments:

1. Comparative study of unconventional Machining processes under following parameters:

   (i) Energy Type (ii) Mechanics of Material Removal (iii) Energy Source (iv) Process

2. Study of working principle, various parts and applications of EDM.
3. Study of working principle, various parts and applications of ECM
4. Study of working principle, various parts and applications of AJM
5. Study of working principle, various parts and applications of Laser Beam Machining Method
6. Study of working principle, various parts and applications of Electron Beam Machining (EBM):
7. Study of working principle, various parts and applications of Plasma Arc Machining (PAM)

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New Scheme Based On AICTE Flexible Curricula

Robotics & Mechatronics, VI-Semester

Departmental Elective RM 603(A) Additive Manufacturing

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

1, Understand the working principles and process parameters of additive manufacturing processes
2,Explore different additive manufacturing processes and suggest suitable methods for building a particular component
3, Perform suitable post processing operation based on product repair requirement
4 Design and develop a working model using additive manufacturing Processes

Unit 1: Introduction to Additive Manufacturing: Introduction to AM, AM evolution, Distinction between AM & CNC machining, Steps in AM, Classification of AM processes, Advantages of AM and Types of materials for AM.

Unit 2: Vat Photopolymerization AM Processes: Stereolithography (SL), Materials, Process Modeling, SL resin curing process, SL scan patterns, Micro-stereolithography, Mask Projection Processes, Two-Photon vat photopolymerization, Process Benefits and Drawbacks, Applications of Vat Photopolymerization, case studies.

Unit 3: Material Jetting AM Processes: Evolution of Printing as an Additive Manufacturing Process, Materials, Process Benefits and Drawbacks, Applications of Material Jetting Processes. Binder Jetting AM Processes: Materials, Process Benefits and Drawbacks, Research achievements in printing deposition, Technical challenges in printing, Applications of Binder Jetting Processes.

Unit 4: Extrusion-Based AM Processes: Fused Deposition Modelling (FDM), Principles, Materials, Process Modelling, Plotting and path control, Bio-Extrusion, Contour Crafting, Process Benefits and Drawbacks, Applications of Extrusion-Based Processes, case studies.

Unit 5 Sheet Lamination AM Processes: Bonding Mechanisms, Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications, case studies.

References

1. Ian Gibson, David W Rosen, Brent Stucker., “Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing”, 2nd Edition, Springer, 2015
2. Patri K. Venuvinod and Weiyin Ma, “Rapid Prototyping: Laser-based and Other Technologies”, Springer, 2004.
3. Chua Chee Kai, Leong Kah Fai, “3D Printing and Additive Manufacturing: Principles & Applications”, 4th Edition, World Scientific, 2015.
4. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001.
5. Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006

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Robotics & Mechatronics, VI-Semester

Departmental Elective RM 603(B) Automation System Design

Course Objective:

This course is aimed at making an Engineer with appropriate experience; a qualified designer of Industrial automation systems with the use of PLCs, PACs, Industrial Field Instruments like temperature/ flow/ pressure sensors and transmitters, control valves, pumps, I/P converters, etc., Industrial PCs, SCADA/HMI, Data-acquisition boards, Machine vision, robots, Microprocessor based instruments, and related Software. The course also includes an industrial oriented project work during which the student will be working on specific assignments of his/her choice

Syllabus

Unit 1: Fundamentals of Automation System Design: Basic concept of Automation System Design, Measurements with Industrial Field Instruments, Data acquisition, analysis and control software NI LabVIEW, Process Plant Control & Automation System Design, Programmable Automation Controllers, (PAC), Automation System Integration & Engineering Concepts.

Unit 2: PLC & PID Controllers & Industrial Networking: Programmable Logic Controllers & PLC interfacing Techniques, Programming of PLC using Ladder diagrams, Function Block diagram & Structured Text Language Troubleshooting and maintenance of PLC systems. Implementation of control techniques using PLC, PLC programming with Allen• Bradley SLC500 series (SLC5/02 & SLC5/04), RS Logix 500 Software, Fundamental process control techniques, Controller tuning methods, Introduction to Industrial, Networking Analog and DigitalCommunications on Plant Floors.

Unit 3: SCADA/ HMI System Development : Introduction to SCADA Different Systems in SCADA like Field Instrumentation, RTUs, communication Networks and Central Monitoring Stations, Intellution's iFIX SCADA Software National Instrument's LabVIEW DSC (Data logging& Supervisory Control) Software HMI Development, Data Processing, Control Algorithm Programming Modem connectivity & SCADA protocols - Modbus/ IEC 60870

Unit 4: Distributed Control Systems: Distributed Control System (DCS) architecture Introduction to ABB, Freelance DCS , Control Builder F Configuration Tool, Project Management and hardware configuration

Unit 5 : Industrial Drives & Robotics : Motors & Drives , DC Motor Drives, AC Motor drives, Embedded Controllers for Drives, Industrial Application of drives, Concepts of Industrial Robots, Classification Robot Task Programming, Applications of Robotics.

REFERENCES:

1. Process Control Systems: Application, Design, and Tuning 4th Edition by F. Gregg Shinskey, McGraw-Hill Professional
2. Process Dynamics and Control by Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, John Wiley & Sons
3. Programmable Controllers - Selected Applications, L. A. Bryan, E. A. Bryan
4. SCADA: Supervisory Control and Data Acquisition, Stuart A. Boyer, ISA
5. Process/ Industrial Instruments and Controls Handbook, by Gregory Mcmillan, Douglas Considine, McGraw-Hill Education
6. . Control systems engineer technical reference handbook By Chuck Cornell, ISA
7. Measurement and Control Basics By Thomas A. Hughes
8. Process Control Instrumentation Technology, Curtis D. Johnson
9. Industrial Ethernet, By Perry S. Marshall and John S. Rinaldi, ISA

Recommended hardware/software tools:

1. Allen Bradley CompactLogix Series PLC (1769 L23 or better) Systems with Digital and Analog I/O modules (isolated)

2. SIEMENS SIMATIC S7 series PLC Systems (1200/300/400 latest CPUs) with Digital and Analog I/O modules (Isolated)

3. ABB AC500 PLC (PM 581-ETH CPU or better) Systems) with Digital and Analog I/O modules (Isolated)

4. HART Modem and Smart Temperature Transmitter with HART interface

5. Smart Transmitter with Profibus interface

6. Analog Isolators -Siemens/ Pepperl make

7. NI Foundation fieldbus training kit

8. Smart Instruments with HART/ Foundation Fieldbus interfaces

9. NI USB-6211 (or better) with connector, cable and accessories

10. cDAQ-9181 CompactDAQ chassis (or better) with thermocouple input module.

11. Distributed Control Systems (DCS) - ABB Freelance 800F with S800 I/O modules and interfaces, Foundation fieldbus and Profibus interfaces

12. Temperature control loop process rig

13. Pressure control loop process rig

14. Level & flow control loop process rig

15. Cascade control loop process rig

The above process rigs must be set up with real sized industrial grade instruments (Level, flow, temperature and pressure sensors and Transmitters, pumps, control valves, positioners and I/P converters) and controlled through PLC/ PAC/ LabVIEW/ SCADA/ DCS

16. Power flex 40 AC Drives with Analog input and Output, Digital Input and Output & Relay outputs

17. ACS550 Ac drive with Analog input and Output, Digital Input and Output & Relay outputs

18. DCS 800 DC Drives with Analog input and Output, Digital Input and Output

19. . Logo Soft SIEMENS PLC with 12 Inputs and 4 Relay Outputs

20. 3 Phase Induction Motor (>1.0 HP)

21. 3 Phase Induction Motor Trainer

22. Permanent Magnet DC Motor 1.0 HP, 180V

23. DC Motor Trainer

24. RS Logix 5000 Software – academic license

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New Scheme Based On AICTE Flexible Curricula

Robotics & Mechatronics, VI-Semester

Departmental Elective RM 603(C) Work Study and Ergonamics

Unit I : Productivity and Work Study

Productivity: Definition of productivity, individual enterprises, task of management, Productivity of materials, and, building, machine and power. Measurement of productivity, factors affecting the productivity, productivity improvement programs.

Work Study: Definition, objective and scope of work study. Human factor in work study,Work study and management, work study and supervision, work study and worker.

Unit II Method Study and Micro and Memo Motion Study

Introduction to Method Study : Definition, objective and scope of method study, activity recording and exam aids. Charts to record moments in shop operation – process charts, flow process charts, travel chart and multiple activity charts.(With simple problems)

Micro and Memo Motion Study :Charts to record moment at work place – principles of motion economy, classification of movements, two handed process chart, SIMO chart, and micro motion study. Development, definition and installation of the improved method.

Unit III: Work Measurement and Time Study

Introduction to Work Measurement: Definition, objective and benefit of work measurement. Work measurement techniques. Work sampling: need, confidence levels, sample size determinations, with simple problems.

Time Study: Time Study, Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating, Systems of rating.

Unit IV Performance Rating

Scales of rating, factors affecting rate of working, allowances and standard time determination. Predetermined motion time study – Method time measurement (MTM)

Wages and Incentives: introduction , definition, wage differentials ,methods of wage payment, Advantages ,disadvantages, Financial incentives, non-financial incentives.

Unit V: Ergonomics and Human Computer interface

Ergonomics: Introduction, areas of study under ergonomics, man-machine system. Components of man-machine system and their functions –, study of development of stress in human body and their consequences. computer based ergonomics. Usability Engineering and

Human Computer interface.

Design of man-machine system: Quantitative, qualitative representation and alphanumeric displays. types of control, layouts of panels and machines. Design of work places, influence of climate on human efficiency. Influence of noise, vibration and light on human efficiency.

REFERENCES:

1. ILO -Introduction to work study, ISBN 13:9788120406025 Publisher: India Book House Pvt. Ltd, 4th Revised Edition,2008.

2. Ralph M Barnes -Motion and Time study, ISBN:13:978981426182 Publisher: John Wiley, 7th edition 2009.

3. M S Sanders and E J McCormic -Human Factors in Engineering Design, ISBN: 13:9780070549012, Mc Graw Hill, 7th Edition,1992.

4. R.S.Bridger -Introduction to Ergonomics, ISBN:13:9780849373060, Publisher Taylor and Francis dated 20th Aug 2008, 3rdEdition.

5.O.P.Khanna, Work study and Ergonamics, Dhanpat Rai & Sons

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New Scheme Based On AICTE Flexible Curricula

Robotics & Mechatronics, VI-Semester

Departmental Elective RM 603(D) Production Planning and Control

Course Outcomes:

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

1. Understand production systems and their characteristics.
2. Evaluate MRP and JIT systems against traditional inventory control systems.
3. Understand basics of variability and its role in the performance of a production system.
4. Analyze aggregate planning strategies.
5. Apply forecasting and scheduling techniques to production systems.
6. Understand theory of constraints for effective management of production systems.

UNIT – I Introduction of Production Planning (PPC) and Control and Forecasting

Introduction of PPC: Definition , Objectives of Production Planning and Control, Functions of production planning and control , Types of production systems, Organization of production planning and control department.
Forecasting ;Definition- uses of forecast- factors affecting the forecast- types of forecasting- their uses, general principle of forecasting. Forecasting techniques- quantitative and qualitative techniques. Measures of forecasting errors.

UNIT – 2 Inventory management and Aggregate Planning :

Inventory management ; Functions of inventories,relevant inventory costs, ABC analysis, VED analysis, Basic EOQ model, Inventory control systems, continuous review systems and periodic review systems, MRP I, MRP II, ERP, JIT Systems, Basic Treatment only.

Aggregate planning ; Definition, aggregate-planning strategies, aggregate planning methods, transportation model.

UNIT – 3 Line Balancing and Routing

Line Balancing: Terminology, Methods of Line Balancing, RPW method, Largest Candidate method and Heuristic method.
Routing; Definition, Routing procedure, Factors affecting routing procedure, Route Sheet

UNIT -4 Scheduling

Scheduling ,Definition, Scheduling Policies, types of scheduling methods, differences with loading flow shop scheduling, job shop scheduling, line of balance (LOB), objectives, steps involved.

UNIT -5 Dispatching and Follow up:

Dispatching: Definition, activities of dispatcher, dispatching procedures, various forms used indispatching.
Follow up: definition, types of follow up, expediting definition, expediting procedures, Applications of computers in planning and control.

REFERENCES

1.Heizer"Operations Management Pearson.

2. Ajay K Garg , Production and Operations Management, Mc Graw Hill

3. S K Mukhopadhyaya, Production Planning and Control, PHI

4. Jain & Jain ,Production Planning and Control, Khanna publications

5. O P Khanna ,Industrial engineering and Management, Dhanpat Rai

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New Scheme Based On AICTE Flexible Curricula

Robotics & Mechatronics, VI-Semester

Open Elective RM 604 (A) Total Quality Management

Course Outcomes:

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

1. Understand TQM Framwork, Quality, customer focus , how to translate needs into requirements
2. Have overview of contributions of Renowned Philosophers of quality management
3. Understand concept of quality circle,statistical process control and process capability.
4. Compare TQM, BPR and Six sigma tools and apply them appropriately in industry.
5. Suggest / Implement guidelines of ISO 9004:2000 in a small industry.

Unit I: Introduction To Quality Management

Definitions – TOM framework, benefits, awareness and obstacles. Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.

Unit II :Principles and Philosophies of Quality Management

Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle, Japanese 5S principles and 8D methodology.

Unit III : Statistical Process Control and Process Capability

Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed.

Process capability, meaning, significance and measurement – Six sigma concepts of process capability.

Reliability concepts; definitions,reliability in series and parallel, product life characteristics curve. Total productive maintenance (TMP) – relevance to TQM, Terotechnology. Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.

Unit IV: Tools and Techniques for Quality Management

Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA), requirements of reliability, failure rate, FMEA stages, design, process and documentation. Seven old (statistical) tools. Seven new management tools. Bench marking and POKA YOKE.

Unit V: Quality Systems Organizing and Implementation

Introduction to IS/ISO 9004:2000, quality management systems, guidelines for performance improvements. Quality Audits. TQM culture, Leadership, quality council, employee involvement, motivation, empowerment, recognition and reward- Introduction to software quality.

REFERENCES:

1. Dale H.Besterfield et al, Total Quality Management, Third edition, Pearson Education (First Indian Reprints 2004).
2. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002
3. M.Mahajan, Total Quality Management, Dhanpat Rai & Co.
4. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
5. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

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New Scheme Based On AICTE Flexible Curricula

Robotics & Mechatronics, VI-Semester

Open Elective RM 604 (B) Probability and Statistics

COURSE OBJECTIVES :

1. To give an exposure to the students the basic concepts of Probability and Statistical methods and their application.
2. To serve as a foundation to analyze problems in Science and Engineering applications through Statistical testing Method.

COURSE OUTCOMES :

Upon successful completion of this course, the student should be able to

1. learn basics of Probability distributions, Sampling theory and Theory of Estimation Various tests of Hypothesis and Significance, Correlation and Regression and fitting of different types of curves
2. Make use of the concepts of probability and their applications
3. Apply discrete and continuous probability distributions
4. Classify the concepts of data science and its importance
5. Interpret the association of characteristics and through correlation and regression tools
6. Design the components of a classical hypothesis test
7. Infer the statistical inferential methods based on small and large sampling tests

Syllabus:

Unit I: Probability Distributions

Review of basic probability; Probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem

Random variables, Probability Distribution, Mathematical Expectation and Variance of Probability distribution, Standard discrete distributions: Binomial, Poisson and Geometrical distributions, Probability density function, Cumu-lative distribution function, Expectation and Variance, Standard continuous distributions – Uniform, Normal, Exponential, Joint distribution and Joint density functions.

Unit II: Sampling Theory

Population and Sample, Statistical inference, Sampling with and without replacement, Random samples, Population parameters, Sample statics, Sampling distributions, Sample mean, Sampling distribution of means, Sample variances, Sampling distribution of variances, Case where population variances is unknown, Unbiased estimates and efficient estimates, point estimate and Interval Estimates, Confidence Interval estimates of population parameters, Confidence intervals for variance of a Normal distribution, Maximum likelihood estimates.

Unit III: Tests of Hypothesis and Significance

Statistical hypothesis, Null and Alternate hypothesis, test of hypothesis and significance, Type I and Type II errors, Level of Sig-nificance, Tests involving the Normal distribution, One-Tailed and Two-Tailed tests, P value. Special tests of significance for Large samples and Small samples (F, chi- square, z, t- test), ANOVA.

Unit IV: Correlation and Regression

Correlation, Rank correlation, Regression Analysis, Linear and Non linear Regression, Multiple regression.

Unit V : Curve fitting

Curve fitting by method of least squares, fitting of straight lines, polynomials, exponential curves.

REFERENCES:

1. E. Walpole, R. H. Mayers, S. L. Mayers and K. Ye, (2007), Probability and Statistics for Engineers and Scientists,8th Edition, Pearson Education, ISBN: 978-8-131-71552-9.
2. Sheldon M. Ross, (2011), Introduction to Probability and Statistics for Engineers and Scientists, 4th Edition, Academic Foundation, ISBN: 978-8-190-93568-5.
3. Douglas C. Montgomery, (2012), Applied Statistics and Probability for Engineers, 5th Edition, , Wiley India, ISBN: 978-8-126-53719-8.
4. Spiegel, M. R., Schiller, J. and Srinivasan, R. A., (2010), Probability & Statistics, 3rdEdition, TataMcGraw Hill, ISBN : 978-0-070-15154-3.
5. B.S.Grewal, Higher engineering Mathematics ,Khanna Publisher
6. B.V.Ramanna ,Higher engineering Mathematics, McGraw Hill Education India
7. H.K.Das Higher engineering Mathematics

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New Scheme Based On AICTE Flexible Curricula

Robotics & Mechatronics, VI-Semester

Open Elective RM 604 (C) Introduction to Machine Learning

COURSE OUTCOMES:

After Completing the course student should be able to:

1. Apply knowledge of computing and mathematics to machine learning problems, models and algorithms; 2. Analyze a problem and identify the computing requirements appropriate for its solution;

3. Design, implement, and evaluate an algorithm to meet desired needs; and

4. Apply mathematical foundations, algorithmic principles, and computer science theory to the modeling and design of computer-based systems in a way that demonstrates comprehension of the trade-offs involved in design choices.

Unit –I Introduction to machine learning: Scope and limitations, regression, probability, statistics and linear algebra for machine learning, convex optimization, data visualization, hypothesis function and testing, data distributions, data preprocessing, data augmentation, normalizing data sets, machine learning models, supervised and unsupervised learning.

Unit –II Linearity vs non linearity: Activation functions like sigmoid, ReLU, etc., weights and bias, loss function, gradient descent, multilayer network, backpropagation, weight initialization, training, testing, unstable gradient problem, auto encoders, batch normalization, dropout, L1 and L2 regularization, momentum, tuning hyper parameters,

Unit –III Convolutional neural network: Flattening, subsampling, padding, stride, convolution layer, pooling layer, loss layer, dance layer 1x1 convolution, inception network, input channels, transfer learning, one shot learning, dimension reductions, implementation of CNN like tensor flow

Unit –IV Recurrent neural network: Long short-term memory, gated recurrent unit, translation, beam search and width, Bleu score, attention model, Reinforcement Learning, RL-framework, MDP, Bellman equations, Value Iteration and Policy Iteration, , Actor-critic model, Q-learning, SARSA

Unit –V Support Vector Machines: Bayesian learning, application of machine learning in computer vision, speech processing, natural language processing etc, Case Study: ImageNet Competition

REFERENCES

1. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer-Verlag New York Inc., 2nd Edition, 2011.

2. Tom M. Mitchell, “Machine Learning”, McGraw Hill Education, First edition, 2017.

3. Ian Goodfellow and Yoshua Bengio and Aaron Courville, “Deep Learning”, MIT Press, 2016

4. Aurelien Geon, “Hands-On Machine Learning with Scikit-Learn and Tensorflow: Concepts, Tools, and Techniques to Build Intelligent Systems”, Shroff/O'Reilly; First edition (2017).

5. Francois Chollet, "Deep Learning with Python", Manning Publications, 1 edition (10 January 2018).

6. Andreas Muller, "Introduction to Machine Learning with Python: A Guide for Data Scientists", Shroff/O'Reilly; First edition (2016).

7. Russell, S. and Norvig, N. “Artificial Intelligence: A Modern Approach”, Prentice Hall Series in Artificial Intelligence. 2003

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New Scheme Based On AICTE Flexible Curricula

Robotics & Mechatronics, VI-Semester

Open Elective RM 604 (D) Internet of Things

Course Objective:

The objective of this course is to provide an understanding of the technologies and the standards relating to the Internet of Things and to develop skills on IoT technical planning.

Course Outcomes:

After the completion of this course, the students will be able to:

1. Understand Internet of Things and its hardware and software components
2. Interface I/O devices, sensors & communication modules
3. Analyze data from various sources in real-time and take necessary actions in an intelligent fashion
4. Remotely monitor data and control devices
5. Develop real life IoT based projects

Unit I

IoT definition, Characteristics, IoT conceptual and architectural framework, Components of IoT ecosystems, Physical and logical design of IoT, IoT enablers, Modern day IoT applications, M2M communications, IoT vs M2M, IoT vs WoT, IoT reference architecture, IoT Network configurations, IoT LAN, IoT WAN, IoT Node, IoT Gateway, IoT Proxy, Review of Basic Microcontrollers and interfacing.

Unit II

Define Sensor, Basic components and challenges of a sensor node, Sensor features, Sensor resolution; Sensor classes: Analog, Digital, Scalar, Vector Sensors; Sensor Types, bias, drift, Hysteresis error, quantization error; Actuator; Actuator types: Hydraulic, Pneumatic, electrical, thermal/magnetic, mechanical actuators, soft actuators

Unit III

Basics of IoT Networking, IoT Components, Functional components of IoT, IoT service oriented architecture, IoT challenges, 6LowPAN, IEEE 802.15.4, ZigBee and its types, RFID Features, RFID working principle and applications, NFC (Near Field communication), Bluetooth, Wireless Sensor Networks and its Applications

Unit IV

MQTT, MQTT methods and components, MQTT communication, topics and applications, SMQTT, CoAP, CoAP message types, CoAP Request-Response model, XMPP, AMQP features and components, AMQP frame types

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Unit V:

IoT Platforms, Arduino, Raspberry Pi Board, Other IoT Platforms; Data Analytics for IoT, Cloud for IoT, Cloud storage models & communication APIs, Attacks in IoT system, vulnerability analysis in IoT, IoT case studies: Smart Home, Smart framing etc.

References:

1. Vijay Madisetti, Arshdeep Bahga, “Ïnternet of Things, A Hands on Approach”, University Press

2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs

3. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases”, CRC Press

4. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi

5. Adrian McEwen, “Designing the Internet of Things”, Wiley

6. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill

7. Cuno Pfister, “Getting Started with the Internet of Things”, O Reilly Media

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Robotics & Mechatronics, VI-Semester

RM 605- Robot Programming

Suggested List of Experiments:

1. Study of the three levels of robot programming .
2. Study of requirements of a robot programming language.
3. Write a robot program (in a language of your choice) to pick a block up from location A and place it in location B
4. Design the syntax of a new robot programming language. Include ways to give duration or speeds to motion trajectories, make I/O statements to peripherals, give commands to control the gripper, and produce force-sensing (i.e., guarded move) commands. You can skip force control and parallelism
5. Using any robot language, write a general routine for unloading an arbitrarily sized pallet. The routine should keep track of indexing through the pallet and signal a human operator when the pallet is empty. Assume the parts are unloaded onto a conveyor belt.
6. Using any capable robot programming language, write a program to assemble the hand-held portion of a standard telephone. The six components (handle, microphone, speaker, two caps, and cord) arrive in a kit, that is, a special pallet holding one of each kind of part. Assume there is a fixture into which the handle can be placed that holds it. Make any other reasonable assumptions needed.
7. Write a robot program that uses two manipulators. One, called GARM, has a special end-effector designed to hold a wine bottle. The other arm, BARM, wifi hold a wineglass and is equipped with a force-sensing wrist that can be used to signal GARM to stop pouring when it senses the glass is full.

References:

[1] B. Shimano, "VAL: A Versatile Robot Programming and Control System," Proceedings of COMIPSAC 1979, Chicago, November 1979.

[2] B. Shimano, C. Geschke, and C. Spalding, "VAL II: A Robot Programming Language and Control System," SME Robots VIII Conference, Detroit, June 1984.

[3] 5. Mujtaba and R. Goldman, "AL Users' Manual," 3rd edition, Stanford Department of Computer Science, Report No. STAN-CS-81-889, December 1981.

[4] A. Gilbert et al., AR-BASIC: An Advanced and User Friendly Programming Systemfor Robots, American Robot Corporation, June 1984.

[5] J. Craig, "JARS—JIPL Autonomous Robot System: Documentation and Users Guide," JPL Interoffice memo, September 1980.

[6] ABB Robotics, "The RAPID Language," in the SC4Plus Controller Manual, ABBRobotics, 2002.

[7] R. Taylor, P. Summers, and J. Meyer, "AML: A Manufacturing Language," International Journal of Robotics Research, Vol. 1, No. 3, Fall 1982.

[8] FANUC Robotics, Inc., "KAREL Language Reference," FANUC Robotics NorthAmerica, mc, 2002.

[9] R. Taylor, "A Synthesis of Manipulator Control Programs from Task-Level Specffications," Stanford University Al Memo 282, July 1976.

New Scheme Based On AICTE Flexible Curricula

Robotics & Mechatronics, VI-Semester

RM 606- Soft Computing Techniques Lab

OBJECTIVES: The Laboratory course should enable the students to:

1. Understand Fuzzyconcepts
2. Learn neural networks with back propagation and withoutpreparation
3. Learn the operators of genetic algorithms
4. Practice on crisp partitions

Suggested List of Experiments:

1. Create a perceptron with appropriate number of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights.
2. Write a program to implement artificial neural network without back propagation. Write a program to implement artificial neural network with back propagation.
3. Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations
4. Implement travelling sales person problem (tsp) using genetic algorithms.
5. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on soya bins data. Analysis of covariance: variance (ANOVA), if data have categorical variables on iris data.
6. Implement linear regression and multi-regression for a set of data points
7. Implement crisp partitions for real-life iris dataset

8. Write a program to implement Hebb's rule Write a program to implement Delta rule

9. Write a program to implement logic gates.

10. Implement svm classification by fuzzy concepts.

REFERENCES:

1. D.K Prathikar, ―Soft Computing, Narosa Publishing House, New Delhi, 2008.

Web References:

1.https://ldrp.ac.in/images/syllabus/BEComputer/8023%20soft%20computing.pdfhttp://itmgoi.in/download/CSE%20&%20IT/Soft%20Computing%20IT%20(IT-802).pdf

2. http://mirlab.org/jang/book/

SOFTWARE AND HARDWARE REQUIREMENTS FOR 30 STUDENTS (One batch):

SOFTWARE: Python

HARDWARE: 30 numbers of Intel Desktop Computers with 4 GB RAM
