

MATHEMATICS – 4 th semester

(All branches except Electrical, Electronics, Computer science, Information Technology and Applied Electronics)

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MAT 202	PROBABILITY, STATISTICS AND NUMERICAL METHODS	BASIC SCIENCE COURSE	3	1	0	4

Preamble: This course introduces students to the modern theory of probability and statistics, covering important models of random variables and techniques of parameter estimation and hypothesis testing. A brief course in numerical methods familiarises students with some basic numerical techniques for finding roots of equations, evaluating definite integrals solving systems of linear equations, and solving ordinary differential equations which are especially useful when analytical solutions are hard to find.

Prerequisite: A basic course in one-variable and multi-variable calculus.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the concept, properties and important models of discrete random variables and, using them, analyse suitable random phenomena.
CO 2	Understand the concept, properties and important models of continuous random variables and, using them, analyse suitable random phenomena.
CO 3	Perform statistical inferences concerning characteristics of a population based on attributes of samples drawn from the population
CO 4	Compute roots of equations, evaluate definite integrals and perform interpolation on given numerical data using standard numerical techniques
CO 5	Apply standard numerical techniques for solving systems of equations, fitting curves on given numerical data and solving ordinary differential equations.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	2	2					2		1
CO 2	3	2	2	2	2					2		1
CO 3	3	2	2	2	2					2		1
CO 4	3	2	2	2	2					2		1
CO 5	3	2	2	2	2					2		1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests(%)		End Semester Examination(%)
	1	2	
Remember	10	10	10
Understand	30	30	30
Apply	30	30	30
Analyse	20	20	20
Evaluate	10	10	10
Create			

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Let X denote the number that shows up when an unfair die is tossed. Faces 1 to 5 of the die are equally likely, while face 6 is twice as likely as any other. Find the probability distribution, mean and variance of X .
2. An equipment consists of 5 componets each of which may fail independently with probability 0.15. If the equipment is able to function properly when at least 3 of the componets are operational, what is the probability that it functions properly?
3. X is a binomial random variable $B(n, p)$ with $n = 100$ and $p = 0.1$. How would you approximate it by a Poisson random variable?
4. Three balls are drawn at random without replacement from a box containing 2 white, 3 red and 4 black balls. If X denotes the number of white balls drawn and Y denotes the number of red balls drawn, find the joint probability distribution of (X, Y)

Course Outcome 2 (CO2)

1. What can you say about $P(X = a)$ for any real number a when X is a (i) discrete random variable? (ii) continuous random variable?

2. A string, 1 meter long, is cut into two pieces at a random point between its ends. What is the probability that the length of one piece is at least twice the length of the other?
3. A random variable has a normal distribution with standard deviation 10. If the probability that it will take on a value less than 82.5 is 0.82, what is the probability that it will take on a value more than 58.3?
4. X and Y are independent random variables with X following an exponential distribution with parameter μ and Y following an exponential distribution with parameter λ . Find $P(X + Y \leq 1)$

Course Outcome 3(CO3):

1. In a random sample of 500 people selected from the population of a city 60 were found to be left-handed. Find a 95% confidence interval for the proportion of left-handed people in the city population.
2. What are the types of errors involved in statistical hypothesis testing. Explain the level of risks associated with each type of error.
3. A soft drink maker claims that a majority of adults prefer its leading beverage over that of its main competitor's. To test this claim 500 randomly selected people were given the two beverages in random order to taste. Among them, 270 preferred the soft drink maker's brand, 211 preferred the competitor's brand, and 19 could not make up their minds. Determine whether there is sufficient evidence, at the 5% level of significance, to support the soft drink maker's claim against the default that the population is evenly split in its preference.
4. A nutritionist is interested in whether two proposed diets, *diet A* and *diet B* work equally well in providing weight-loss for customers. In order to assess a difference between the two diets, she puts 50 customers on diet A and 60 other customers on diet B for two weeks. Those on the former had weight losses with an average of 11 pounds and a standard deviation of 3 pounds, while those on the latter lost an average of 8 pounds with a standard deviation of 2 pounds. Do the diets differ in terms of their weight loss?

Course Outcome 4(CO4):

1. Use Newton-Raphson method to find a real root of the equation $f(x) = e^{2x} - x - 6$ correct to 4 decimal places.
2. Compare Newton's divided difference method and Lagrange's method of interpolation.

3. Use Newton's forward interpolation formula to compute the approximate values of the function f at $x = 0.25$ from the following table of values of x and $f(x)$

x	0	0.5	1	1.5	2
$f(x)$	1.0000	1.0513	1.1052	1.1618	1.2214

4. Find a polynomial of degree 3 or less the graph of which passes through the points $(-1,3)$, $(0,-4)$, $(1,5)$ and $(2,-6)$

Course Outcome 5 (CO5):

- Apply Gauss-Seidel method to solve the following system of equations

$$\begin{aligned} 4x_1 - x_2 - x_3 &= 3 \\ -2x_1 + 6x_2 + x_3 &= 9 \\ -x_1 + x_2 + 7x_3 &= -6 \end{aligned}$$
- Using the method of least squares fit a straight line of the form $y = ax + b$ to the following set of ordered pairs (x, y) :
 $(2,4), (3,5), (5,7), (7,10), (9,15)$
- Write the normal equations for fitting a curve of the form $y = a_0 + a_1x^2$ to a given set of pairs of data points.
- Use Runge-Kutta method of fourth order to compute $y(0.25)$ and $y(0.5)$, given the initial value problem
 $y' = x + xy + y, y(0) = 1$

Syllabus

Module 1 (Discrete probability distributions)

9 hours

(Text-1: *Relevant topics* from sections-3.1-3.4, 3.6, 5.1)

Discrete random variables and their probability distributions, Expectation, mean and variance, Binomial distribution, Poisson distribution, Poisson approximation to the binomial distribution, Discrete bivariate distributions, marginal distributions, Independent random variables, Expectation -multiple random variables.

Module 2 (Continuous probability distributions)

9 hours

(Text-1: *Relevant topics* from sections-4.1-4.4, 3.6, 5.1)

Continuous random variables and their probability distributions, Expectation, mean and variance, Uniform, exponential and normal distributions, Continuous bivariate distributions, marginal distributions, Independent random variables, Expectation-multiple random variables, i.i.d random variables and Central limit theorem (**without proof**).

Module 3 (Statistical inference)

9 hours

(Text-1: *Relevant topics from sections-5.4,, 3.6, 5.1,7.2, 8.1, 8.3, 9.1-9.2,9.4*)

Population and samples, Sampling distribution of the mean and proportion (for large samples only), Confidence interval for single mean and single proportions(for large samples only). Test of hypotheses: Large sample test for single mean and single proportion, equality of means and equality of proportions of two populations, small sample t-tests for single mean of normal population, equality of means (**only pooled t-test, for independent samples from two normal populations with equal variance**)

Module 4 (Numerical methods -I)

9 hours

(Text 2- *Relevant topics from sections 19.1, 19.2, 19.3, 19.5*)

Errors in numerical computation-round-off, truncation and relative error, Solution of equations – Newton-Raphson method and Regula-Falsi method. Interpolation-finite differences, Newton's forward and backward difference method, Newton's divided difference method and Lagrange's method. Numerical integration-Trapezoidal rule and Simpson's 1/3rd rule (**Proof or derivation of the formulae not required for any of the methods in this module**)

Module 5 (Numerical methods -II)

9 hours

(Text 2- *Relevant topics from sections 20.3, 20.5, 21.1*)

Solution of linear systems-Gauss-Siedal and Jacobi iteration methods. Curve fitting-method of least squares, fitting straight lines and parabolas. Solution of ordinary differential equations-Euler and Classical Runge-Kutta method of second and fourth order, Adams-Moulton predictor-correction method (**Proof or derivation of the formulae not required for any of the methods in this module**)

Text Books

1. (Text-1) Jay L. Devore, *Probability and Statistics for Engineering and the Sciences*, 8th edition, Cengage, 2012
2. (Text-2) Erwin Kreyszig, *Advanced Engineering Mathematics*, 10 th Edition, John Wiley & Sons, 2016.

Reference Books

1. Hossein Pishro-Nik, *Introduction to Probability, Statistics and Random Processes*, Kappa Research, 2014 (Also available online at www.probabilitycourse.com)
2. Sheldon M. Ross, *Introduction to probability and statistics for engineers and*

- scientists*, 4th edition, Elsevier, 2009.
3. T. Veera Rajan, *Probability, Statistics and Random processes*, Tata McGraw-Hill, 2008
 4. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 36 Edition, 2010.

Assignments

Assignments should include specific problems highlighting the applications of the methods introduced in this course in physical sciences and engineering.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Discrete Probability distributions	9 hours
1.1	Discrete random variables and probability distributions, expected value, mean and variance (discrete)	3
1.2	Binomial distribution-mean, variance, Poisson distribution-mean, variance, Poisson approximation to binomial	3
1.3	Discrete bivariate distributions, marginal distributions, Independence of random variables (discrete), Expected values	3
2	Continuous Probability distributions	9 hours
2.1	Continuous random variables and probability distributions, expected value, mean and variance (continuous)	2
2.2	Uniform, exponential and normal distributions, mean and variance of these distributions	4
2.3	Continuous bivariate distributions, marginal distributions, Independent random variables, Expected values, Central limit theorem.	3
3	Statistical inference	9 hours
3.1	Population and samples, Sampling distribution of single mean and single proportion(large samples)	1
3.2	Confidence interval for single mean and single proportions (large samples)	2
3.3	Hypothesis testing basics, large sample test for single proportion, single proportion	2
3.4	Large sample test for equality of means and equality of proportions of two populations	2

3.5	t-distribution and small sample t-test for single mean and pooled t-test for equality of means	2
4	Numerical methods-I	9 hours
4.1	Roots of equations- Newton-Raphson, regulafalsi methods	2
4.2	Interpolation-finite differences, Newton's forward and backward formula,	3
4.3	Newton's divided difference method, Lagrange's method	2
4.3	Numerical integration-trapezoidal rule and Simpson's 1/3-rd rule	2
5	Numerical methods-II	9 hours
5.1	Solution of linear systems-Gauss-Siedal method, Jacobi iteration method	2
5.2	Curve-fitting-fitting straight lines and parabolas to pairs of data points using method of least squares	2
5.3	Solution of ODE-Euler and Classical Runge-Kutta methods of second and fourth order	4
5.4	Adams-Moulton predictor-corrector methods	1



Model Question Paper
(2019 Scheme)

Reg No:
Name:

Total Pages: 4

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION

(Month & year)

Course Code: MAT

Course Name: PROBABILITY, STATISTICS AND NUMERICAL METHODS

(Common to all branches except (i) Electrical and Electronics, (ii) Electronics and Communication, (iii) Applied Electronics and Instrumentation (iv) Computer Science and Engineering (v) Information Technology)

Max Marks :100

Duration : 3 Hours

PART A

(Answer all questions. Each question carries 3 marks)

1. Suppose X is binomial random variable with parameters $n = 100$ and $p = 0.02$. Find $P(X < 3)$ using Poisson approximation to X . (3)
2. The diameter of circular metallic discs produced by a machine is a random variable with mean 6cm and variance 2cm. Find the mean area of the discs. (3)
3. Find the mean and variance of the continuous random variable X with probability density function (3)

$$f(x) = \begin{cases} 2x - 4, & 2 \leq x \leq 3 \\ 0 & \text{otherwise} \end{cases}$$
4. The random variable X is exponentially distributed with mean 3. Find $P(X > t + 3 | X > t)$ where t is any positive real number. (3)
5. The 95% confidence interval for the mean mass (in grams) of tablets produced by a machine is [0.56 0.57], as calculated from a random sample of 50 tablets. What do you understand from this statement? (3)
6. The mean volume of liquid in bottles of lemonade should be at least 2 litres. A sample of bottles is taken in order to test whether the mean volume has fallen below 2 litres. Give a null and alternate hypothesis for this test and specify whether the test would be one-tailed or two-tailed. (3)
7. Find all the first and second order forward and backward differences of y for the following set of (x, y) values: (0.5, 1.13), (0.6, 1.19), (0.7, 1.26), (0.8, 1.34) (3)
8. The following table gives the values of a function $f(x)$ for certain values of x . (3)

x	0	0.25	0.50	0.75	1
$f(x)$	1	0.9412	0.8	0.64	0.5

Evaluate $\int_0^1 f(x)dx$ using trapezoidal rule.

9. Explain the principle of least squares for determining a line of best fit to a given data (3)
10. Given the initial value problem $y' = y + x$, $y(0) = 0$, find $y(0.1)$ and $y(0.2)$ using Euler method. (3)

PART B
(Answer one question from each module)
MODULE 1

11. (a) The probability mass function of a discrete random variable is $p(x) = kx$, $x = 1, 2, 3$ where k is a positive constant. Find (i) the value of k (ii) $P(X \leq 2)$ (iii) $E[X]$ and (iv) $\text{var}(1 - X)$. (7)
- (b) Find the mean and variance of a binomial random variable (7)

OR

12. (a) Accidents occur at an intersection at a Poisson rate of 2 per day. what is the probability that there would be no accidents on a given day? What is the probability that in January there are at least 3 days (not necessarily consecutive) without any accidents? (7)
- (b) Two fair dice are rolled. Let X denote the number on the first die and $Y = 0$ or 1 , according as the first die shows an even number or odd number. Find (i) the joint probability distribution of X and Y , (ii) the marginal distributions. (iii) Are X and Y independent ? (7)

MODULE 2

13. (a) The IQ of an individual randomly selected from a population is a normal distribution with mean 100 and standard deviation 15. Find the probability that an individual has IQ (i) above 140 (ii) between 120 and 130. (7)
- (b) A continuous random variable X is uniformly distributed with mean 1 and variance $4/3$. Find $P(X < 0)$ (7)

OR

14. (a) The joint density function of random variables X and Y is given by (7)

$$f(x, y) = \begin{cases} e^{-(x+y)}, & x > 0, \quad y > 0 \\ 0 & \text{otherwise.} \end{cases}$$

Find $P(X + Y \leq 1)$. Are X and Y independent? Justify.

- (b) The lifetime of a certain type of electric bulb may be considered as an exponential random variable with mean 50 hours. Using central limit theorem, find the approximate probability that 100 of these electric bulbs will provide a total of more than 6000 hours of burning time. (7)

MODULE 3

15. (a) The mean blood pressure of 100 randomly selected persons from a target population is 127.3 units. Find a 95% confidence interval for the mean blood pressure of the population. (7)
- (b) The CEO of a large electric utility claims that 80 percent of his 1,000,000 customers are very satisfied with the service they receive. To test this claim, the local newspaper surveyed 100 customers, using simple random sampling. Among the sampled customers, 73 percent say they are very satisfied. Based on these findings, do you think that the CEO is making a false claim of high satisfaction levels among his customers? Use a 0.05 level of significance. (7)

OR

16. (a) A magazine reported the results of a telephone poll of 800 adult citizens of a country. The question posed was: "Should the tax on cigarettes be raised to pay for health care reform?" The results of the survey were: Out of the 800 persons surveyed, 605 were non-smokers out of which 351 answered "yes" and the rest "no". Out of the remaining 195, who were smokers, 41 answered "yes" and the remaining "no". Is there sufficient evidence, at the 0.05 significance level, to conclude that the two populations smokers and non-smokers differ significantly with respect to their opinions? (7)
- (b) Two types of cars are compared for acceleration rate. 40 test runs are recorded for each car and the results for the mean elapsed time recorded below: (7)

	Sample mean	Sample standard deviation
Car A	7.4	1.5
Car B	7.1	1.8

determine if there is a difference in the mean elapsed times of the two car models at 95% confidence level.

MODULE 4

17. (a) Use Newton-Raphson method to find a non-zero solution of $x = 2 \sin x$. Start with $x_0 = 1$ (7)
- (b) Using Lagrange's interpolating polynomial estimate $f(1.5)$ for the following data (7)

x	0	1	2	3
$y = f(x)$	0	0.9826	0.6299	0.5532

OR

18. (a) Consider the data given in the following table (7)

x	0	0.5	1	1.5	2
$f(x)$	1.0000	1.0513	1.1052	1.1618	1.2214

Estimate the value of $f(1.80)$ using newton's backward interpolation formula.

- (b) Evaluate $\int_0^1 e^{-x^2/2} dx$ using Simpson's one-third rule, dividing the interval $[0, 1]$ into 8 subintervals (7)

MODULE 5

19. (a) Using Gauss-Seidel method, solve the following system of equations (7)

$$\begin{aligned} 20x + y - 2z &= 17 \\ 3x + 20y - z &= -18 \\ 2x - 3y + 20z &= 25 \end{aligned}$$

- (b) The table below gives the estimated population of a country (in millions) for during 1980-1995 (7)

year	1980	1985	1990	1995
population	227	237	249	262

Plot a graph of this data and fit an appropriate curve to the data using the method of least squares. Hence predict the population for the year 2010.

OR

20. (a) Use Runge-Kutta method of fourth order to find $y(0.2)$ given the initial value problem (7)

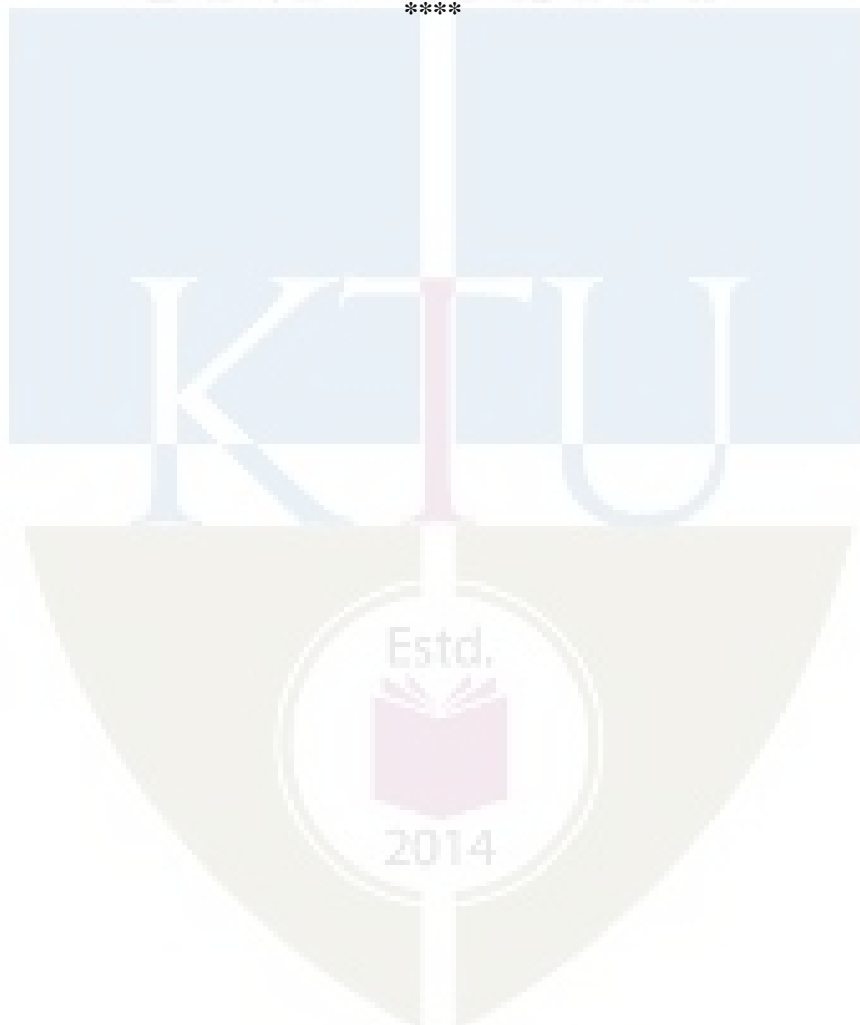
$$\frac{dy}{dx} = \frac{xy}{1+x^2}, \quad y(0) = 1$$

Take step-size, $h = 0.1$.

- (b) Solve the initial value problem (7)

$$\frac{dy}{dx} = x + y, \quad y(0) = 0,$$

in the interval $0 \leq x \leq 1$, taking step-size $h = 0.2$. Calculate $y(0.2)$, $y(0.4)$ and $y(0.6)$ using Runge-Kutta second order method, and $y(0.8)$ and $y(1.0)$ using Adam-Moulton predictor-corrector method.



RAT 202	KINEMATICS AND DYNAMICS OF MECHANISMS	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the kinematic details of machines, kinematic pairs and degrees of freedom and determining the loop closure equations of various linkages and find known and unknown coordinates
CO 2	Determine the velocity and acceleration of a point in open loop planar mechanisms.
CO 3	Analyze the static force in simple mechanisms and determine the forces for a particular acceleration using inverse dynamics
CO 4	Determine equations of motion and acceleration equations for various planar mechanisms, and identify the known and unknown variables for forward dynamic analysis
CO 5	Illustrate the derivation of Euler's dynamic equations for pure rotation from Newton's laws and solve simple problems using this method.
CO 6	Understand the free, damped and forced vibration of single DoF systems

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	1									3
CO 2	3	3	3									3
CO 3	3	3	3									3
CO 4	3	3	3									3
CO 5	3	3	3									3
CO 6	3	3	3									3

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Understand the kinematic details of machines, kinematic pairs and degrees of freedom and determining the loop closure equations of various linkages and find known and unknown coordinates

Course Outcome 2 (CO2): Determine the velocity and acceleration of a point in open loop planar mechanisms.

Course Outcome 3 (CO3): Analyze the static force in simple mechanisms and determine the forces for a particular acceleration using inverse dynamics

Course Outcome 4 (CO4): Determine equations of motion and acceleration equations for various planar mechanisms, and identify the known and unknown variables for forward dynamic analysis

Course Outcome 5 (CO5): Illustrate the derivation of Euler's dynamic equations for pure rotation from Newton's laws and solve simple problems using this method.

Course Outcome 6 (CO6): Understand the free, damped and forced vibration of single DoF systems

Syllabus

Module 1

Basics of mechanisms: Links, kinematic pairs, kinematic chain, mechanism and machine, schematic diagrams and description of common mechanisms like linkages, cam-follower mechanisms, gear trains, belt and chain drives-no derivations, and multi-degrees of planar mechanisms in machines like earth moving machinery and planar versions of manipulators, mobility /degrees of freedom (DoF), Kutzbach's formula, determination of DoF of planar linkages and mechanisms with cam-follower pairs. Definition of position analysis problem, loop closure equations, derivation of solutions for simple mechanisms like fourbar, slider-crank, and multi DoF closed and open loop mechanisms, multiple branches of solution, exposure to graphical approach, inverse pose problem of an open loop 3R planar manipulator, and derivation of solution.

Module 2

Velocity analysis: Definition of the velocity analysis problem, angular velocity of a rigid link and relative velocity of points, analytical method of velocity analysis, derivation of equations and numerical solutions, forward and inverse velocity analysis of open loop 3R mechanism. **Acceleration analysis:** Definition of the acceleration analysis problem, angular acceleration of a rigid link and relative acceleration of points, Coriolis's acceleration, analytical method of acceleration analysis and derivation of equations, numerical solution for simple mechanisms.

Module 3

Static force analysis: Free body diagrams, nature of joint reaction forces, static force analysis, application to simple linkages and cam-follower mechanisms. **Inverse dynamic analysis:** Definition of the inverse dynamic analysis problem, inertia forces and moments, equations of motion, derivation of equations of motion for planar mechanisms with single and multi DoF, D'Alembert's principle, virtual work principle and workless nature of constraint reaction forces, generalized coordinates and forces, derivation of equations using generalized coordinates and virtual work principle.

Module 4

Forward dynamic analysis: Definition of the forward dynamic analysis problem, acceleration of links in terms of acceleration of independent coordinates, combining dynamic equations with acceleration equations, derivation of complete set of equations for single and multi DoF planar mechanisms, introduction to simulation of mechanisms (Assignment only no university questions)

Module 5

Euler's equation for rigid body rotation: Derivation of Euler's dynamic equations for pure rotation from Newton's laws, moments of inertia, principal moments and principal axes, representation of relative orientation of reference frames using rotation matrices, properties of rotation matrices, transformation of moments of inertia matrices from one reference frame to another, Euler's equations in principal reference frame, applications of Euler's equations, simple applications of Euler's equation. **Introduction to vibration of single DoF systems:** Free undamped and damped vibration, underdamped, critically damped, and overdamped systems-no derivations, examples, harmonically forced vibration of undamped and damped systems, phase plane representation.

Text Books

1. Kinematics and Dynamics of Machinery ,Author:Norton R L ,Publisher:McGraw-Hill
2. Theory of Machines and Mechanisms 4th Edition, Author:John J. Uicker. Jr ,Gordon R. Pennock, Joseph E. Shigley,Publisher:Oxford HED

Reference Books

1. Kinematics, Dynamics and Design of Machinery, 3rd Edition, 2016", Authors: Kenneth J. Waldron, Gary L. Kinzel, Sunil K. Agrawal, Publisher: Willey
2. Fundamentals of Kinematics and Dynamics of Machines and Mechanisms, Author:Oleg Vinogradov,Publisher:CRC press
3. Theory of Machines, Author:Rattan S S ,Publisher:Tata McGraw-Hill
4. Mechanism and Machine Theory ,Author:Ambekar ,Publisher : A G, Prentice Hall
5. Theory of Machines ,Author : V P Singh ,Publisher : Dhanpat Rai & Co

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Module-1	
1.1	Links, kinematic pairs, kinematic chain, mechanism and machine, schematic diagrams and description of common mechanisms like linkages, cams-follower mechanisms (no numerical problems), gear trains, belt and chain drives-basic types and selection (no numerical problems, no derivations).	2
1.2	Multi-degrees of planar mechanisms in machines like earth moving machinery and planar versions of manipulators	2
1.3	Mobility /degrees of freedom (DoF), Kutzbach's formula, determination of DoF of planar linkages and mechanisms with cam-follower pairs-practical problems	2
1.4	Definition of position analysis problem, loop closure equations-practical problems, derivation of solutions for simple mechanisms like fourbar, slider-crank, and multi DoF closed and open loop mechanisms, 3R planar manipulator	3
2	Module-2	
2.1	Definition of the velocity analysis problem, angular velocity of a rigid link and relative velocity of points, analytical method of velocity analysis-numerical problems by analytical method only.	3
2.2	forward and inverse velocity analysis of open loop 3R mechanism	2
2.3	Definition of the acceleration analysis problem, angular acceleration of a rigid link and relative acceleration of points, Coriolis's acceleration-derivation of Coriolis's component of acceleration.	2
2.4	Analytical method of acceleration analysis - numerical solution for simple mechanisms.	2
3	Module-3	
3.1	Free body diagrams, nature of joint reaction forces, static force analysis, application to simple linkages and cam-follower mechanisms	2
3.2	Definition of the inverse dynamic analysis problem, inertia forces and moments, equations of motion, derivation of equations of motion for planar mechanisms with single and multi DoF, D'Alembert's principle	3
3.3	Virtual work principle and workless nature of constraint reaction forces-numerical problems	1
3.4	Generalized coordinates and forces, derivation of equations using generalized coordinates and virtual work principle-practical problems (formulation of equations only)	3

4	Module-4	
4.1	Definition of the forward dynamic analysis problem, acceleration of links in terms of acceleration of independent coordinates	3
4.2	Derivation of complete set of equations for single and multi DoF planar mechanisms	4
4.3	Introduction to simulation of mechanisms-demonstration and assignment using matlab Scilab.	2
5	Module-5	
5.1	Derivation of Euler's dynamic equations for pure rotation from Newton's laws	2
5.2	Moments of inertia, principal moments and principal axes, representation of relative orientation of reference frames using rotation matrices, properties of rotation matrices, transformation of moments of inertia matrices from one reference frame to another, Euler's equations in principal reference frame, simple applications of Euler's equation	3
5.3	Free undamped and damped vibration, underdamped, critically damped, and overdamped systems, examples-numerical problems, no derivations, harmonically forced vibration of undamped and damped systems-numerical problems only, no derivation, phase plane representation-basic concept only.	4

MODEL QUESTION PAPER

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B.TECH. DEGREE EXAMINATION**

Course Code: RAT 202

Course Name: KINEMATICS AND DYNAMICS OF MECHANISMS

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

Marks

- | | | |
|---|--|------|
| 1 | Explain the terms links, kinematic pairs and kinematic chain. | (3) |
| 2 | With the help of an example explain degree of freedom of a mechanism. | (3) |
| 3 | Derive the expression for Coriolis' component of acceleration on a slider move up with velocity V m/s along a rotating link with clockwise angular velocity ω rad/s | (3) |
| 4 | Write various steps to find inverse velocity of a two link planar open chain | (3) |

mechanism by analytical approach.

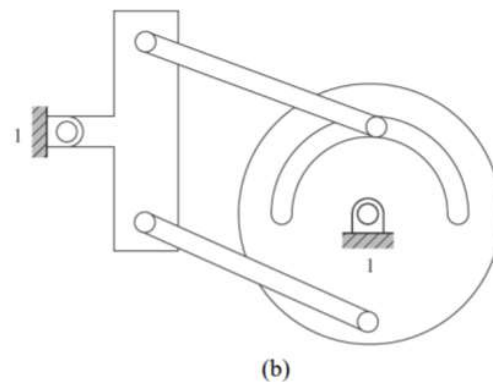
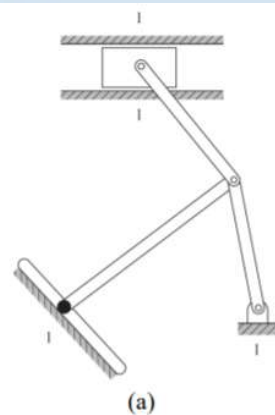
- 5 Draw the free body diagram of various linkages of a slider crank mechanism. (3)
- 6 Write the D'Alembert's equations for the connecting rod of a slider crank mechanism. (3)
- 7 With the help of an example explain the application of principle of virtual work to determine unknown static force in a planar mechanism. (3)
- 8 Write the Euler's equation for pure rigid body rotation about a point. (3)
- 9 What is the relevance of principal moment of inertia in rotation motion (3)
- 10 Draw the displacement time graph for critically damped, under damped and over damped vibration of a spring mass damper system. (3)

PART B

Answer any one full question from each module, each carries 14 marks.

MODULE 1

11



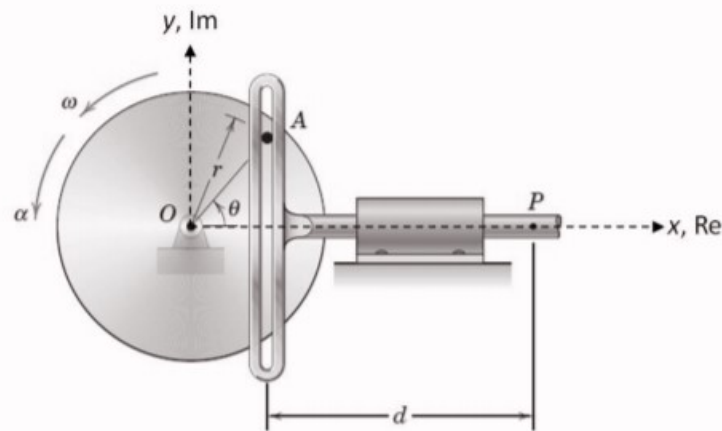
14

Use the Kutzbach's criterion determine the mobility of the planar mechanisms illustrated above. Clearly number each link and label lower pair by 'L' and higher pair by 'H'. In the figure 1 represents fixed link.

2014

12

(14)



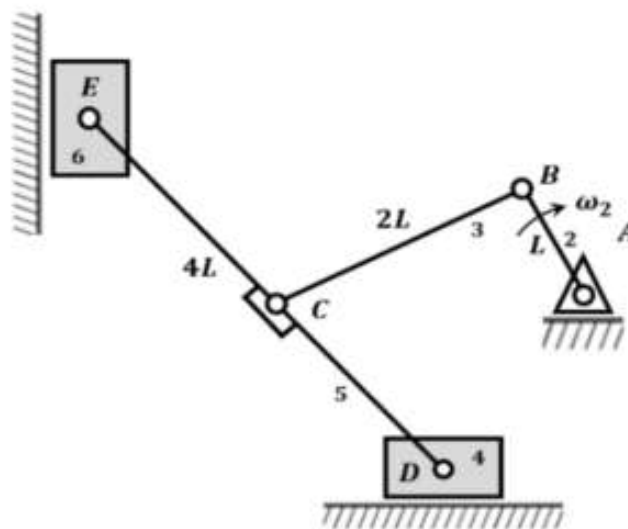
- (a) Write the position loop closure equation of the mechanism by indicating position vector using two letters (b) Show the position vector shown as arrows
- (b) Write the position loop closure equation of the mechanisms by complex number in exponential form.

MODULE II

13

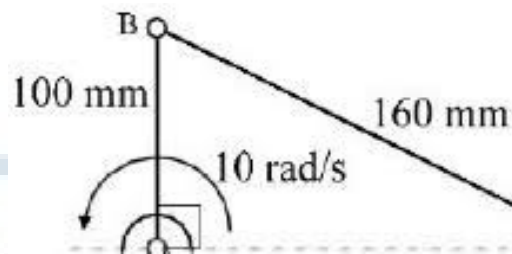
$L=1\text{m}$, C is midpoint of ED , $\omega=10\text{rad/s}$, find velocity of D and E

(14)



14

(14)



Determine the acceleration of link C by analytical approach

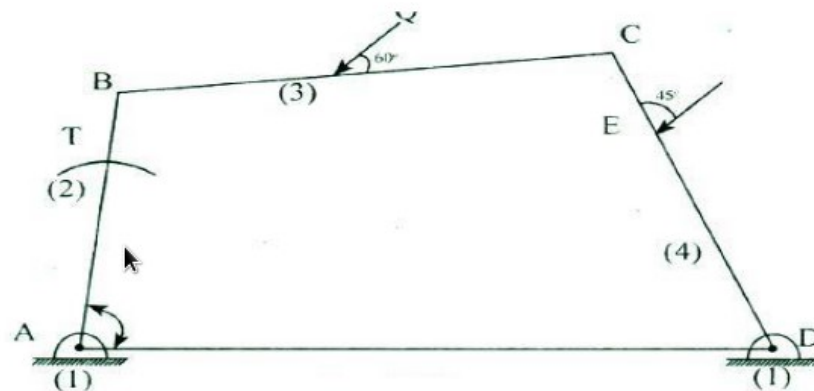
MODULE III

15 Determine the torque required to be applied at the crankshaft of a slider crank (14)

mechanism to bring it in equilibrium. The slider is subjected to a horizontal force of 500N and a force of magnitude 1000N applied on the connecting rod at an angle 60° . The dimension of various linkages are $OA=250\text{mm}$, $AB=750\text{mm}$, and $AC=250\text{mm}$, $\angle BOA=40^\circ$.

16 A four bar mechanism under the action of two external forces is shown below (14)

Determine the torque to be applied on the link AB for static equilibrium. The dimensions of the links are $AB = 50\text{ mm}$, $BC = 66\text{ mm}$, $CD = 55\text{ mm}$, $CE = 25\text{ mm}$, $CF = 30\text{ mm}$, $AD=100\text{ mm}$, angle $BAD = 60^\circ$, $P = 500\text{N}$ and $Q = 600\text{N}$



MODULE IV

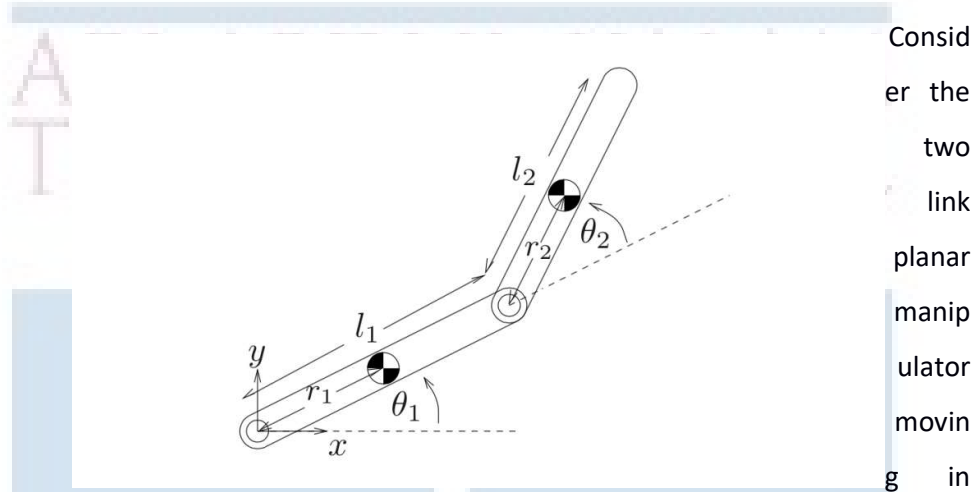
17 In a four bar mechanism the link AB rotates with angular velocity of 20rad/s (14)

and angular acceleration of 100 rad/s both in clockwise direction when it make

an angle of 45° with link AD which is fixed .The length of various linkages are $AB=CD=400$ mm, $BC=500$ mm and $AD=750$ mm .Neglect the gravitational effect and friction.The mass of link is 5kg/m. Find the torque on output link

18

(14)



horizontal plane,derive the dynamic equations. Take m_1 as mass of first link and m_2 as mass of second link

MODULE V

19

(14)

A machine part of 2kg mass vibrates in a viscous medium .Determine the damping coefficient when a harmonic excitation force of 25N result in a resonant amplitude of 12.5 mm with a period of 0.1s,if the system is excited by a harmonic force of 4Hz frequency,what will be the percentage increase in amplitude of vibration when the damper is removed as compared to that with damper?

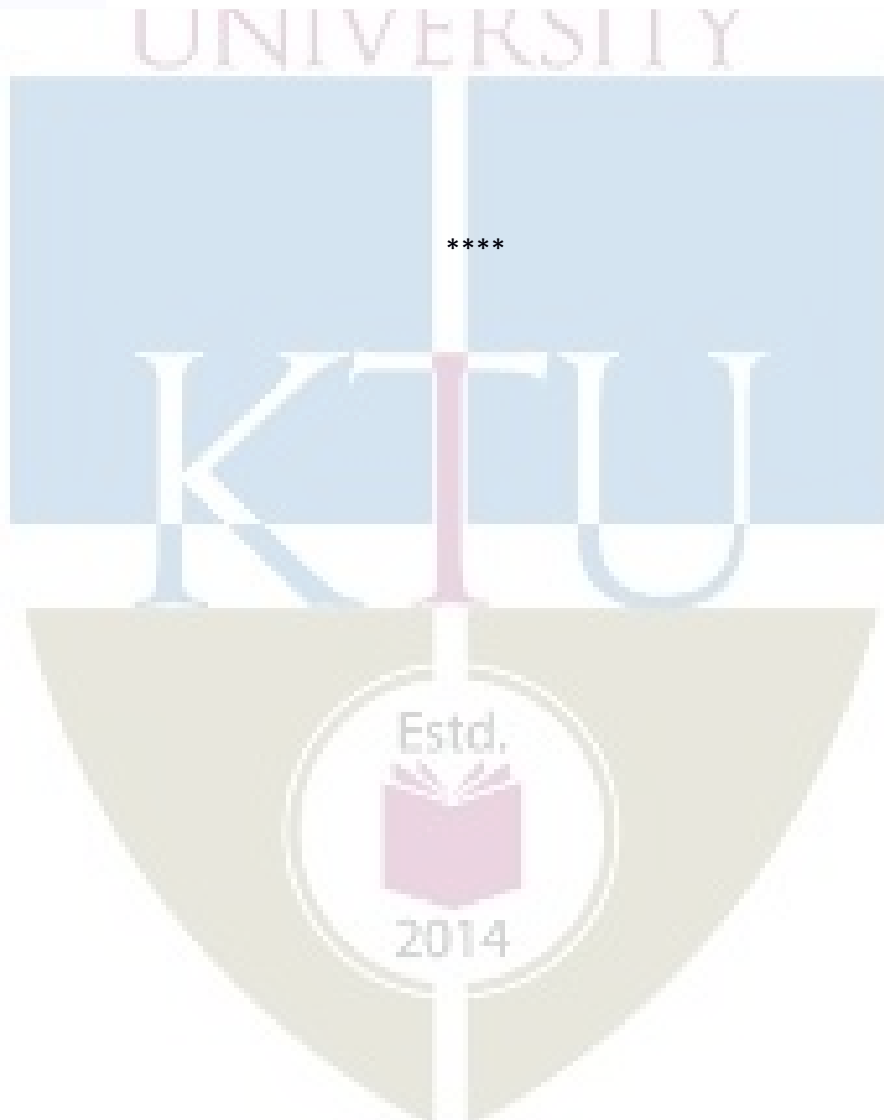
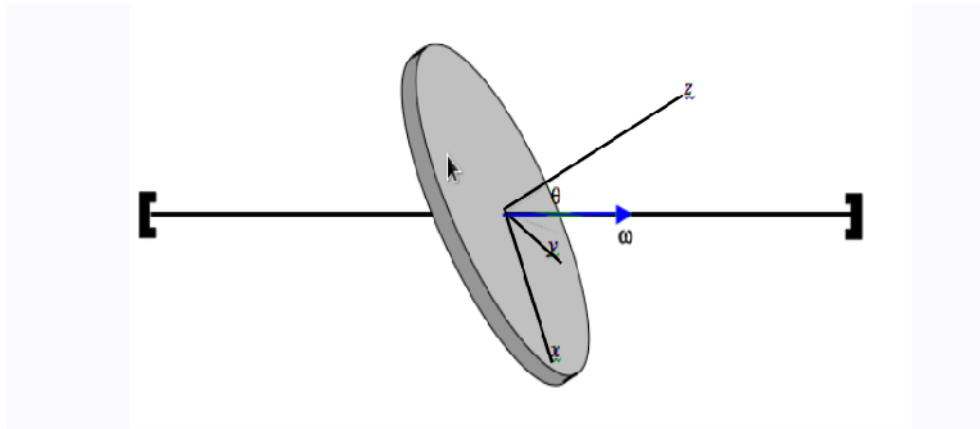
20

(4)

a)Write the Euler's equation for rigid body rotation and explain each terms.

b)A disc of mass m , radius a , spinning at a constant angular speed ω about at axle that is inclined at an angle ϑ to the normal to the disc. Find the torque on the disc

(10)



RAT 204	MANUFACTURING PROCESSES	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the basics of the primary manufacturing processes and apply the knowledge in designing parts for robotic applications
CO 2	Understand the various joining processes and choose the appropriate mechanical and adhesive joining process for the parts.
CO 3	Understand the conventional machining operations and to decide the optimal parameters for a specific machining requirement.
CO 4	Understand the operations in a CNC machine and optimally choose the parameters and settings for a specific machining requirement.
CO 5	Decide the datum and tool offset parameters for the required machining operation and to manually program the CNC machine.
CO 6	Understand the various nonconventional and net-shape manufacturing techniques and optimally select the appropriate process to realise a part.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2										3
CO 2	3	2										3
CO 3	3	3										3
CO 4	3	3										3
CO 5	3	2	2		3							3
CO 6	3	2	3									

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

When is forging preferred over casting? Evaluate the design considerations when casting is to be the preferred manufacturing process?

Course Outcome 2 (CO2):

Describe a suitable method of welding solder tabs to the terminals of Ni-Cd batteries. What are the major factors to be considered in selecting a process for this application?

Course Outcome 3 (CO3):

List out the design considerations for a part made by turning and explain their significances.

Suggest the sequence of operations to be performed for obtaining a given part.

Course Outcome 4 (CO4):

What are the major advantages of CNC machines over conventional machines? Suggest a suitable process sequence and number of work piece setting up required to realise a given part in a cnc turning center.

Course Outcome 5 (CO5):

For a given part, decide the optimal work reference points and write a CNC part program.

Course Outcome 6 (CO6):

Explain the various additive manufacturing process and discuss their relative merits and demerits.

Suggest a suitable sequence of non-conventional process sequence for realising a given part.

Syllabus**Module 1**

Primary processes – Casting –Forging – Forming – Extrusion-wire drawing process – Rolling –. Selection of primary forming process for various products. Selection of primary forming process. Defects and Design considerations in casting, forging and rolling.

Module 2

Joining processes – Welding – Gas welding– Arc Welding, shielded metal arc welding, submerged arc welding, GTAW, plasma arc welding, ultrasonic welding, friction welding, resistance spot welding, resistance seam welding, stud welding, percussion welding – Soldering – techniques, types of solders and fluxes- Adhesive bonding-types of adhesives-curing techniques. Selection of joining process for various applications, case studies.

Module 3

Machining operations – Milling – types of operations, types of milling machines, milling cutters
 Turning – types of operations , tool holders, inserts, operating conditions, work holding devices,
 Milling and drilling jigs and fixtures. Grinding – types of operations.

Module 4

Numerical controlled Machines – CNC machines, basic structures of machining and turning centers.
 Tools, tool holders and tool indexing. Axis configurations and fundamentals of CNC codes. Datum
 and tool offset settings, Incremental and absolute programming, Canned cycles. Practical
 programming (simple) examples in milling and turning using G, M codes. APT programming

Module 5

Non-conventional processes – EDM, ECM, USM, EBM, LBM, IBM, WJM, AWJM, LJM, ECG, PCM,
 process capabilities, applications, fused ion beams -principle and application, abrasive water jet
 machining.

Net shape and near net shape manufacturing, additive manufacturing, Powder metallurgy, selective
 laser sintering and selective laser melting, fused deposition modelling, laminated object
 manufacturing, laser engineered net-shaping, laser welding, stereo-lithography, LIGA process;

Rapid prototyping, introduction, product prototyping, solid modelling, reverse engineering, process
 chain, advantages of RP (Basic concepts). Selection of rapid prototyping process and design
 considerations

Text Books

1. Manufacturing Engineering and Technology, Kalpakjian and Schmid, Prentice Hall, New Jersey, 2013.
2. Fundamentals of Modern Manufacturing, Mikell P. Groover, John Wiley & Sons, Inc, New Jersey, 2010.
3. Mechatronics by HMT, Tata McGraw Hill, 2010.
4. Manufacturing Engineering, D.K. Singh, Ane Books India, 2008
5. Manufacturing Processes for Engineering Materials, Kalpakjian and Schmid, Pearson Education, 5/e.

Course Contents and Lecture Schedule

Module	Contents	Hrs
1	Primary processes – Casting – sand casting, moulds, types of moulding sand, types of patterns, pattern materials – Forging – forging methods, precision forging, coining, heading, piercing, die design, die materials and lubrication, forging machines – Forming – Extrusion process, hot extrusion, cold extrusion, impact extrusion, wire drawing process – Rolling – principles of rolling, types of rolling mill, hot and cold rolling, rolling mills, ring rolling, thread rolling, applications – rolling of tubes, wheels, axles and I-beams. Importance of material selection for manufacturing processes.	6

	Selection of primary forming process and suitable materials for various products. Defects and Design considerations in casting, forging and rolling.	4
2	Joining processes – Welding – Gas welding, flame characteristics, equipment, fluxes, filler rods – Arc Welding, applications and equipment, electrodes, shielded metal arc welding, submerged arc welding, GTAW, plasma arc welding, ultrasonic welding, friction welding, resistance spot welding, resistance seam welding, stud welding, percussion welding – Soldering – techniques, types of solders and fluxes- Adhesive bonding-types of adhesives-curing techniques. Selection of joining process for various applications, Weldability of different materials -Case studies.	8
3	Machining operations – Milling – types of operations like face milling, end milling, form milling, angular milling, slitting, gear cutting, key way milling, helical milling, profile milling, types of milling machines, milling cutters – Turning – types of operations like chamfering, parting, threading, boring, drilling, knurling, tool holders, inserts, operating conditions, work holding device, Milling and drilling jigs and fixtures. Grinding – types of operations like surface, cylindrical centre less, form and profile, plunge cut, electrochemical, grinders; Machinability of materials and its effect on process parameters.	8
4	Numerical controlled Machines – CNC machines, basic structures of machining and turning centers. Tools, tool holders and tool indexing. Axis configurations and fundamentals of CNC codes. Datum and tool offset settings, Incremental and absolute programming, Canned cycles. Practical programming (simple) examples in milling and turning using G, M codes. APT programming	10
5	Non-conventional processes – EDM, ECM, USM, EBM, LBM, IBM, WJM, AWJM, LJM, ECG, PCM, process capabilities, applications, fused ion beams - principle and application, abrasive water jet machining.	4
	Net shape and near net shape manufacturing, additive manufacturing, Powder metallurgy, selective laser sintering and selective laser melting, fused deposition modelling, laminated object manufacturing, laser engineered net-shaping, laser welding, stereo-lithography, LIGA process; Rapid prototyping, introduction, product prototyping, solid modelling, reverse engineering, process chain, advantages of RP (Basic concepts). Selection of rapid prototyping process and design considerations	5

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B.TECH. DEGREE EXAMINATION

Course Code: RAT 204

Course Name: MANUFACTURING PROCESSES

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

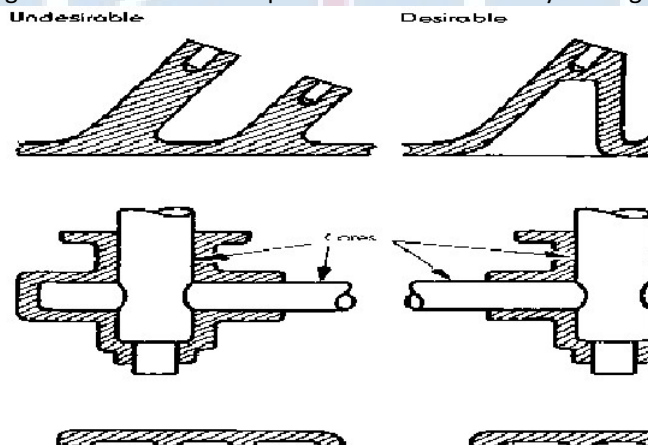
- | | | Marks |
|----|--|-------|
| 1 | List any three advantages of forging over casting. | (3) |
| 2 | Explain the use of chills in casting. | (3) |
| 3 | Explain the different types of oxy-acetylene and their uses. | (3) |
| 4 | List any three uses of ultrasonic welding. | (3) |
| 5 | Distinguish between up milling and down milling. | (3) |
| 6 | Distinguish between jigs and fixtures. | (3) |
| 7 | Explain canned cycles in CNC programming. | (3) |
| 8 | Explain cutter radius compensation. | (3) |
| 9 | Distinguish between selective laser sintering and selective laser melting. | (3) |
| 10 | Explain any two additive manufacturing techniques. | (3) |

PART B

Answer any one full question from each module, each carries 14 marks.

MODULE I

- 11 a) Explain the advantages of casting over other primary manufacturing processes. What are the design considerations for a part that is to be made by casting? (6)
- b) (8)



Three designs of parts that are to be made with casting is shown above with their desirable modifications. State the factors that are considered for the redesigns.

- 12 a) Explain any six defects in castings and the remedies during design of parts and moulds. (6)
- b) Explain the various steps involved in rolling of a wheel rim from a circular disc. (8)

MODULE II

- 13 a) Explain the gas metal arc welding process and its advantages. What are the modes in which metal is transferred across the arc in GMAW? (6)
- b) Thick steel plates of a ship's vertical hull are to be welded effectively. Suggest a suitable welding process for this application and explain the process with suitable schematics. (8)
- 14 a) A FRP tubular shaft is to be fixed with metal end connectors. Explain the various configurations of adhesive bonded joints for this purpose if the torque transmitted through the joint is to be maximized. (8)
- b) Describe a suitable method of welding solder tabs to the terminals of Ni-Cd batteries. (6)

What are the major factors to be considered in selecting a process for this application?

MODULE III

- 15 a) List out the design considerations for a part made by turning and explain their significances. (6)
b) (8)

APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY

Suggest the sequence of operations to be performed for obtaining the given part.

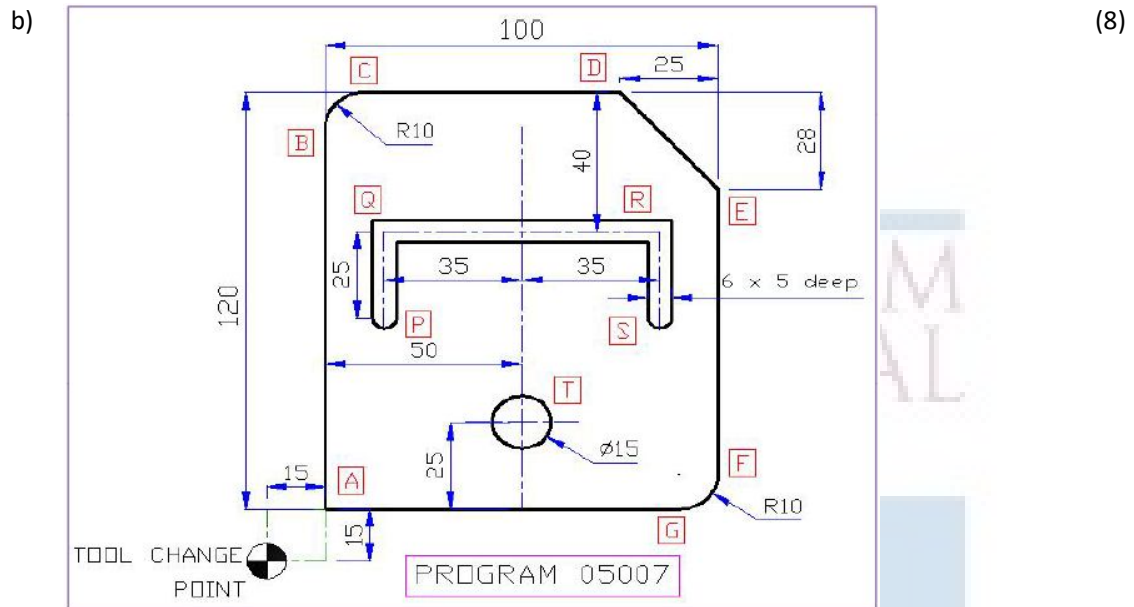
- 16 a) Explain any two methods for cutting helical gears with neat sketches. (6)
b) A spur gear is to be connected to a shaft with a key. Explain the machining sequences required with necessary sketches to machine the key ways on the gear and the shaft. (8)

MODULE IV

- 17 a) (8)

Prepare a CNC program for the above rough turning operation.

- b) Explain the canned cycle for peck drilling with an example. (6)
18 a) Explain the use of absolute and incremental programming with a suitable CNC program. (6)



Prepare a CNC program for milling the above part.

MODULE V

- 19 a) A thick metal sheet is to be cut to make a very intricately shaped object. If the profile to be cut is 2D, how will you choose the option between waterjet cutting and electro discharge machining? What are the factors you will consider if the process is done on a mass production level? (8)
- b) Compare the process capabilities of LBM and EBM. (6)
- 20 a) Metal posts of 1micron dia and 3micron length are to be made on a metal surface. Suggest the process sequence for LIGA process to make this product. (6)
- b) Compare the process capabilities of Stereo lithography and Fused deposition modelling. (8)

Estd.



2014

RAT 206	MICROCONTROLLERS AND EMBEDDED SYSTEMS	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the internal architecture of 8051 Microcontroller
CO 2	Develop simple programs for 8051 using assembly language programming
CO 3	Interface 8051 microcontroller with peripheral devices using ALP/Embedded C
CO 4	Interpret the architecture and design concept of embedded systems
CO 5	Design embedded systems based on Arduino
CO 6	Explain the concepts of embedded operating system

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1				2					2	2
CO 2	3	3	3			2					2	2
CO 3	3	3	3			2					2	2
CO 4	3	1									2	2
CO 5	3	3	3			2					2	2
CO 6	2	1				1					1	1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Module 1: 8051 microcontroller

Review-Basics of Computer Architecture

8051 microcontrollers: Difference between microprocessor and microcontroller Architecture, 8051 pin diagram; Architecture, I/O Port structure, Register organization - special function registers, Memory organization

8051 microcontrollers: Instruction set, Addressing modes

Simple Assembly language programs: Arithmetic (Addition, Subtraction, Multiplication & Division), Transfer a block of data from one internal memory location to another

Module 2: 8051 microcontroller Programming and Peripherals.

Timers/Counters- Serial Communication, Interrupt structure-programming

Interfacing of peripherals – LED (ALP and embedded C programming).

OLED, LCD, ADC, DAC, sensors, simple Switch and key board interfacing, 7 segment LED (embedded C programming).

Module 3: Embedded Systems Overview

Introduction to Embedded Systems: Definition, Features, Simple Example of Embedded Systems, Applications of embedded systems-Consumer electronics, Robotics, Automobiles

Embedded System Architecture: HW - Processor, Controller, SoC, Memory, Peripherals; SW - Application, Middleware, OS, Device Drivers, Tool chain- Assembler, Interpreter, Compiler, Linker, Loader, Debugger

Embedded system design process: Requirement Analysis, Specification Development, HW & SW Co-Design and Development, Module Integration, Testing.

Module 4: Embedded System Board Study (Arduino Uno)

Arduino Uno Board: Board Study (Board level Block schematic) - Chip (Features only - Architecture not needed), GPIO, Memory, Programming Interface

Programming: Arduino IDE, Sample Code (LED, Switch, DC motor, Stepper motor control), Temperature monitoring system using LM35 Temperature sensor & Seven Segment display

Module 5: Introduction to OS and Communication Protocols

Embedded Operating system basic concepts: Functional layers in a computer system OS terminology, Kernel Functions (Overview only), Types of Kernels (Monolithic kernel & Microkernel), Tasks/ Processes.

Introduction to RTOS: Real time tasks and Systems, RTOS basics, Comparison of General Purpose OS and Real Time OS.

Communication Protocols: RS232, I2C, SPI and USB

Text Books

1. Muhammad Ali Mazidi, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson, 2nd Edition, 2007.

2. Lyla B Das, "Embedded Systems: An Integrated Approach", 1e, 2012
3. Michael McRoberts, "Beginning Arduino", Apress, 1e, 2011
4. Kenneth Ayala, "The 8051 Microcontroller", Cengage Learning, 3e, 2012

Reference Books

1. Raj Kamal, "Embedded Systems Architecture, programming and Design", Tata McGraw-Hill, 3e, 2013
2. Tammy Noergaard, Embedded Systems Architecture, A Comprehensive Guide for Engineers and Programmers, Newnes – Elsevier, 2e, 2012
3. James Arthur, "Arduino: The complete guide to Arduino for beginners, including projects, tips, tricks", and programming, Ingram, 1e, 2019

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	8051 microcontroller.	
1.1	Review-Basics of Computer Architecture: Basic Block Diagram of a computer, Buses, Processor, System Clock, Memory, I/O, Von Neumann Architecture-Harward Architecture - RISC vs CISC	2
1.2	8051 microcontrollers: Microcontroller→ a small computer in a single IC chip-Difference between microprocessor and microcontroller Architecture, 8051 pin diagram; Architecture, I/O Port structure, Register organisation -special function registers, Memory organization	4
1.3	8051 microcontrollers: Instruction set, Addressing modes	2
1.4	Simple Assembly language programs: Arithmetic (Addition, Subtraction, Multiplication & Division), Transfer a block of data from one internal memory location to another	2
2	8051 microcontroller Programming and Peripherals.	
2.1	Timers/Counters- Serial Communication, Interrupt structure- ALP programming	2
2.2	Interfacing of peripherals - ALP and embedded C programming	
i	LED,	1
	Interfacing of peripherals - embedded C programming	
ii	OLED	1
iii	LCD	2
iv	ADC, DAC	2
v	sensors, simple Switch and key board interfacing, 7 segment LED	3
3	Embedded Systems Overview	
3.1	Introduction to Embedded Systems: Definition, Features, Simple Example of Embedded Systems, Applications of embedded systems-Consumer electronics, Robotics, Automobiles	2
3.2	Embedded System Architecture: HW - Processor, Controller, SoC, Memory, Peripherals; SW - Application, Middleware, OS, Device Drivers, Tool chain-Assembler, Interpreter, Compiler, Linker, Loader, Debugger	4

3.3	Embedded system design process: Requirement Analysis, Specification Development, HW & SW Co-Design and Development, Module Integration, Testing.	2
4	Embedded System Board Study (Arduino Uno)	
4.1	Arduino Uno Board: Board Study (Board level Block schematic) - Chip (Features only - Architecture not needed), GPIO, Memory, Programming Interface	4
4.2	Programming: Arduino IDE, Sample Code (LED, Switch, DC motor, Stepper motor control), Temperature monitoring system using LM35 Temperature sensor & Seven Segment display	4
5	Introduction to OS and Communication Protocols	
5.1	Embedded Operating system basic concepts: Functional layers in a computer system OS terminology, Kernel Functions (Overview only), Types of Kernels (Monolithic kernel & Microkernel), Tasks/ Processes.	3
5.2	Introduction to RTOS: Real time tasks and Systems, RTOS basics, Comparison of General Purpose OS and Real Time OS	3
5.3	Communication Protocols: RS232, I2C, SPI & USB	2

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRD SEMESTER B.TECH. DEGREE EXAMINATION

Course Code: RAT 206

Course Name: MICROCONTROLLERS AND EMBEDDED SYSTEMS

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

		Marks
1	Which are different types of computer memory?	(3)
2	Difference between microprocessor and microcontroller Architecture.	(3)
3	Explain interrupt structure of 8051	(3)
4	Which are the registers used for timer programming in 8051?	(3)
5	Explain the distinct features of embedded systems	(3)
6	What is meant by hardware software co-design?	(3)
7	Briefly explain features of Arduino Uno board	(3)
8	What is an IDE? What are the features of Arduino IDE?	(3)
9	Differentiate between Monolithic kernel & Microkernel.	(3)
10	Why do we need RTOS?	(3)

PART B

Answer any one full question from each module, each carries 14 marks.

MODULE I

- 11 a) With the help of Block Diagram explain architecture of a computer (6)
 b) Explain register organization of 8051 microcontroller (8)
- 12 a) Write an ALP program to Transfer a block of data from one internal memory location to another (8)
 b) Explain the different addressing modes of 8051. (6)

MODULE II

- 13 a) Write an ALP or Embedded C program to interface LCD with 8051 (10)
 b) Explain the registers used for serial port programming in 8051 (4)
- 14 a) Explain with the help of a program how keyboard can be interfaced with 8051 (10)
 b) Explain the structure of TMOD register. (4)

MODULE III

- 15 a) Compare embedded system with a general purpose computing system (6)
 b) Explain Embedded product development Life Cycle water fall model (8)
- 16 a) Explain the selection criteria of an embedded processor for an applications (4)
 b) What is the function of Assemblers, Compilers, linkers, Loaders and Debuggers (10)

MODULE IV

- 17 a) Explain the technical specifications of Arduino Uno. (8)
 b) Which are the general pin functions of Arduino Uno.? (6)
- 18 a) What does GPIO Stand for? What are its functions? How do you configure them? (10)
 b) Write a program for blinking of LED using Arduino Uno (5)

MODULE V

- 19 a) With the help of a diagram explain Functional layers in a computer system OS terminology (8)
 b) Compare General Purpose OS with Real Time OS (6)
- 20 a) Explain the important functions of OS kernel (7)
 b) Discuss the features of Communication Protocols RS232 and I2C (7)

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
			2	0	0	2
EST 200	DESIGN AND ENGINEERING					

Preamble:

The purpose of this course is to

- i) introduce the undergraduate engineering students the fundamental principles of design engineering,
- ii) make them understand the steps involved in the design process and
- iii) familiarize them with the basic tools used and approaches in design.

Students are expected to apply design thinking in learning as well as while practicing engineering, which is very important and relevant for today. Case studies from various practical situations will help the students realize that design is not only concerned about the function but also many other factors like customer requirements, economics, reliability, etc. along with a variety of life cycle issues.

The course will help students to consider aesthetics, ergonomics and sustainability factors in designs and also to practice professional ethics while designing.

Prerequisite:

Nil. The course will be generic to all engineering disciplines and will not require specialized preparation or prerequisites in any of the individual engineering disciplines.

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Explain the different concepts and principles involved in design engineering.
CO 2	Apply design thinking while learning and practicing engineering.
CO 3	Develop innovative, reliable, sustainable and economically viable designs incorporating knowledge in engineering.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1					1			1		
CO 2		2				1		1				2
CO 3			2			1	1		2	2		1

Assessment Pattern

Continuous Internal Evaluation (CIE) Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination (ESE) Pattern: There will be two parts; Part A and Part B.

Part A : 30 marks

part B : 70 marks

Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions.

Part B contains 2 case study questions from each module of which student should answer any one. Each question carry 14 marks and can have maximum 2 sub questions.

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	5	5	10
Understand	10	10	20
Apply	35	35	70
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course Level Assessment Questions

Course Outcome 1 (CO1): Appreciate the different concepts and principles involved in design engineering.

1. State how engineering design is different from other kinds of design
2. List the different stages in a design process.
3. Describe design thinking.
4. State the function of prototyping and proofing in engineering design.
5. Write notes on the following concepts in connection with design engineering 1) Modular Design, 2) Life Cycle Design, 3) Value Engineering, 4) Concurrent Engineering, and 5) Reverse Engineering
6. State design rights.

Course Outcome 2 (CO2) Apply design thinking while learning and practicing engineering.

1. Construct the iterative process for design thinking in developing simple products like a pen, umbrella, bag, etc.
2. Show with an example how divergent-convergent thinking helps in generating alternative designs and then how to narrow down to the best design.
3. Describe how a problem-based learning helps in creating better design engineering solutions.
4. Discuss as an engineer, how ethics play a decisive role in your designs

Course Outcome 3 (CO3): Develop innovative, reliable, sustainable and economically viable designs incorporating different segments of knowledge in engineering.

1. Illustrate the development of any simple product by passing through the different stages of design process
2. Show the graphical design communication with the help of detailed 2D or 3D drawings for any simple product.
3. Describe how to develop new designs for simple products through bio-mimicry.

Model Question paper

Page 1 of 2

Reg No.: _____ Name: _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION****Course Code: EST 200****Course Name: DESIGN AND ENGINEERING****Max. Marks: 100 Duration: 3 Hours****PART A****Answer all questions, each question carries 3 marks****Use only hand sketches**

- (1) Write about the basic design process.
 - (2) Describe how to finalize the design objectives.
 - (3) State the role of divergent-convergent questioning in design thinking.
 - (4) Discuss how to perform design thinking in a team managing the conflicts.
 - (5) Show how engineering sketches and drawings convey designs.
 - (6) Explain the role of mathematics and physics in design engineering process.
 - (7) Distinguish between project-based learning and problem-based learning in design engineering.
 - (8) Describe how concepts like value engineering, concurrent engineering and reverse engineering influence engineering designs?
 - (9) Show how designs are varied based on the aspects of production methods, life span, reliability and environment?
 - (10) Explain how economics influence the engineering designs?
- (10x3 marks =30 marks)**

Part B**Answer any ONE question from each module. Each question carry 14 marks****Module 1**

- (11) Show the designing of a wrist watch going through the various stages of the design process. Use hand sketches to illustrate the processes.
- or**
- (12) Find the customer requirements for designing a new car showroom. Show how the design objectives were finalized considering the design constraints?

Module 2

- (13) Illustrate the design thinking approach for designing a bag for college students within a limited budget. Describe each stage of the process and the iterative procedure involved. Use hand sketches to support your arguments.

or

- (14) Construct a number of possible designs and then refine them to narrow down to the best design for a drug trolley used in hospitals. Show how the divergent-convergent thinking helps in the process. Provide your rationale for each step by using hand sketches only.

Module 3

- (15) Graphically communicate the design of a thermo flask used to keep hot coffee. Draw the detailed 2D drawings of the same with design detailing, material selection, scale drawings, dimensions, tolerances, etc. Use only hand sketches.

or

- (16) Describe the role of mathematical modelling in design engineering. Show how mathematics and physics play a role in designing a lifting mechanism to raise 100 kg of weight to a floor at a height of 10 meters in a construction site.

Module 4

- (17) Show the development of a nature inspired design for a solar powered bus waiting shed beside a highway. Relate between natural and man-made designs. Use hand sketches to support your arguments.

or

- (18) Show the design of a simple sofa and then depict how the design changes when considering 1) aesthetics and 2) ergonomics into consideration. Give hand sketches and explanations to justify the changes in designs.

Module 5

- (19) Examine the changes in the design of a foot wear with constraints of 1) production methods, 2) life span requirement, 3) reliability issues and 4) environmental factors. Use hand sketches and give proper rationalization for the changes in design.

or

- (20) Describe how to estimate the cost of a particular design using ANY of the following: i) a website, ii) the layout of a plant, iii) the elevation of a building, iv) an electrical or electronic system or device and v) a car.

Show how economics will influence the engineering designs. Use hand sketches to support your arguments.

(5x14 marks =70 marks)

Syllabus

Module 1

Design Process:- Introduction to Design and Engineering Design, Defining a Design Process:-Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.

Module 2

Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment.

Module 3

Design Communication (Languages of Engineering Design):-Communicating Designs Graphically, Communicating Designs Orally and in Writing. Mathematical Modeling In Design, Prototyping and Proofing the Design.

Module 4

Design Engineering Concepts:-Project-based Learning and Problem-based Learning in Design.Modular Design and Life Cycle Design Approaches. Application of Bio-mimicry,Aesthetics and Ergonomics in Design. Value Engineering, Concurrent Engineering, and Reverse Engineering in Design.

Module 5

Expediency, Economics and Environment in Design Engineering:-Design for Production, Use, and Sustainability. Engineering Economics in Design. Design Rights. Ethics in Design

Text Books

- 1) YousefHaik, SangarappillaiSivaloganathan, Tamer M. Shahin, Engineering Design Process, Cengage Learning 2003, Third Edition, ISBN-10: 9781305253285,
- 2) Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN 9332535051

Reference Books

- 1.Philip Kosky, Robert Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition, ISBN: 9780128012420.
2. Clive L. Dym, Engineering Design: A Project-Based Introduction, John Wiley & Sons, New York 2009, Fourth Edition, ISBN: 978-1-118-32458-5
3. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers 2011, First Edition, ISBN: 978-1847886361
4. Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., Engineering Design: A Systematic Approach, Springer 2007, Third Edition, ISBN 978-1-84628-319-2

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	<u>Module 1: Design Process</u>	
1.1	Introduction to Design and Engineering Design. <i>What does it mean to design something? How Is engineering design different from other kinds of design? Where and when do engineers design? What are the basic vocabulary in engineering design? How to learn and do engineering design.</i>	1
1.2	Defining a Design Process:- Detailing Customer Requirements. <i>How to do engineering design? Illustrate the process with an example. How to identify the customer requirements of design?</i>	1
1.3	Defining a Design Process:- Setting Design Objectives, Identifying Constraints, Establishing Functions. <i>How to finalize the design objectives? How to identify the design constraints? How to express the functions a design in engineering terms?</i>	1
1.4	Defining a Design Process:- Generating Design Alternatives and Choosing a Design. <i>How to generate or create feasible design alternatives? How to identify the "best possible design"?</i>	1
1.5	Case Studies:- Stages of Design Process. <i>Conduct exercises for designing simple products going through the different stages of design process.</i>	1
2	<u>Module 2: Design Thinking Approach</u>	
2.1	Introduction to Design Thinking <i>How does the design thinking approach help engineers in creating innovative and efficient designs?</i>	1
2.2	Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. <i>How can the engineers arrive at better designs utilizing the iterative design thinking process (in which knowledge acquired in the later stages can be applied back to the earlier stages)?</i>	1
2.3	Design Thinking as Divergent-Convergent Questioning. <i>Describe how to create a number of possible designs and then how to refine and narrow down to the 'best design'.</i>	1
2.4	Design Thinking in a Team Environment. <i>How to perform design thinking as a team managing the conflicts ?</i>	1
2.5	Case Studies: Design Thinking Approach. <i>Conduct exercises using the design thinking approach for</i>	1

	<i>designing any simple products within a limited time and budget</i>	
3	<u>Module 3: Design Communication (Languages of Engineering Design)</u>	
3.1	Communicating Designs Graphically. <i>How do engineering sketches and drawings convey designs?</i>	1
3.2	Communicating Designs Orally and in Writing. <i>How can a design be communicated through oral presentation or technical reports efficiently?</i>	1
First Series Examination		
3.3	Mathematical Modelling in Design. <i>How do mathematics and physics become a part of the design process?</i>	1
3.4	Prototyping and Proofing the Design. <i>How to predict whether the design will function well or not?</i>	1
3.5	Case Studies: Communicating Designs Graphically. <i>Conduct exercises for design communication through detailed 2D or 3D drawings of simple products with design detailing, material selection, scale drawings, dimensions, tolerances, etc.</i>	1
4	<u>Module 4: Design Engineering Concepts</u>	
4.1	Project-based Learning and Problem-based Learning in Design. <i>How engineering students can learn design engineering through projects?</i> <i>How students can take up problems to learn design engineering?</i>	1
4.2	Modular Design and Life Cycle Design Approaches. <i>What is modular approach in design engineering? How it helps?</i> <i>How the life cycle design approach influences design decisions?</i>	1
4.3	Application of Bio-mimicry, Aesthetics and Ergonomics in Design. <i>How do aesthetics and ergonomics change engineering designs?</i> <i>How do the intelligence in nature inspire engineering designs? What are the common examples of bio-mimicry in engineering?</i>	1
4.4	Value Engineering, Concurrent Engineering, and Reverse Engineering in Design. <i>How do concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?</i>	1
4.5	Case Studies: Bio-mimicry based Designs. <i>Conduct exercises to develop new designs for simple</i>	1

	<i>products using bio-mimicry and train students to bring out new nature inspired designs.</i>	
5	<u>Module 5: Expediency, Economics and Environment in Design Engineering</u>	
5.1	Design for Production, Use, and Sustainability. <i>How designs are finalized based on the aspects of production methods, life span, reliability and environment?</i>	1
5.2	Engineering Economics in Design. <i>How to estimate the cost of a particular design and how will economics influence the engineering designs?</i>	1
5.3	Design Rights. <i>What are design rights and how can an engineer put it into practice?</i>	1
5.4	Ethics in Design. <i>How do ethics play a decisive role in engineering design?</i>	1
5.5	Case Studies: Design for Production, Use, and Sustainability. <i>Conduct exercises using simple products to show how designs change with constraints of production methods, life span requirement, reliability issues and environmental factors.</i>	1
Second Series Examination		



Code.	Course Name	L	T	P	Hrs	Credit
HUT 200	Professional Ethics	2	0	0	2	2

Preamble: To enable students to create awareness on ethics and human values.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the core values that shape the ethical behaviour of a professional.
CO 2	Adopt a good character and follow an ethical life.
CO 3	Explain the role and responsibility in technological development by keeping personal ethics and legal ethics.
CO 4	Solve moral and ethical problems through exploration and assessment by established experiments.
CO 5	Apply the knowledge of human values and social values to contemporary ethical values and global issues.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1								2			2	
CO 2								2			2	
CO 3								3			2	
CO 4								3			2	
CO 5								3			2	

Assessment Pattern

Bloom's category	Continuous Assessment Tests		End Semester Exam
	1	2	
Remember	15	15	30
Understood	20	20	40
Apply	15	15	30

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Tests (2 Nos)	: 25 marks
Assignments/Quiz	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

1. Define integrity and point out ethical values.
2. Describe the qualities required to live a peaceful life.
3. Explain the role of engineers in modern society.

Course Outcome 2 (CO2)

1. Derive the codes of ethics.
2. Differentiate consensus and controversy.
3. Discuss in detail about character and confidence.

Course Outcome 3(CO3):

1. Explain the role of professional's ethics in technological development.
2. Distinguish between self interest and conflicts of interest.
3. Review on industrial standards and legal ethics.

Course Outcome 4 (CO4):

1. Illustrate the role of engineers as experimenters.
2. Interpret the terms safety and risk.
3. Show how the occupational crimes are resolved by keeping the rights of employees.

Course Outcome 5 (CO5):

1. Exemplify the engineers as managers.
2. Investigate the causes and effects of acid rain with a case study.
3. Explore the need of environmental ethics in technological development.

Model Question paper

QP CODE:

Reg No: _____

PAGES:3

Name : _____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD/FOURTH SEMESTER
B.TECH DEGREE EXAMINATION, MONTH & YEAR**

Course Code: HUT 200

Course Name: PROFESSIONAL ETHICS

Max. Marks: 100

Duration: 3 Hours

(2019-Scheme)

PART A**(Answer all questions, each question carries 3 marks)**

1. Define empathy and honesty.
2. Briefly explain about morals, values and ethics.
3. Interpret the two forms of self-respect.
4. List out the models of professional roles.
5. Indicate the advantages of using standards.
6. Point out the conditions required to define a valid consent?
7. Identify the conflicts of interests with an example?
8. Recall confidentiality.
9. Conclude the features of biometric ethics.
10. Name any three professional societies and their role relevant to engineers.

(10x3 = 30 marks)

PART B**(Answer one full question from each module, each question carries 14 marks)****MODULE I**

11. a) Classify the relationship between ethical values and law?

b) Compare between caring and sharing.

(10+4 = 14 marks)

Or

12. a) Exemplify a comprehensive review about integrity and respect for others.

b) Discuss about co-operation and commitment.

(8+6 = 14 marks)

MODULE II

13.a) Explain the three main levels of moral developments, devised by Kohlberg.

b) Differentiate moral codes and optimal codes.

(10+4 = 14 marks)

Or

14. a) Extrapolate the duty ethics and right ethics.

b) Discuss in detail the three types of inquiries in engineering ethics

(8+6 = 14 marks)

MODULE III

15.a) Summarize the following features of morally responsible engineers.

(i) Moral autonomy

(ii) Accountability

b) Explain the rights of employees

(8+6 = 14 marks)

Or

16. a) Explain the reasons for Chernobyl mishap ?

b) Describe the methods to improve collegiality and loyalty.

(8+6 = 14 marks)

MODULE IV

17.a) Execute collegiality with respect to commitment, respect and connectedness.

b) Identify conflicts of interests with an example.

(8+6 = 14 marks)

Or

18. a) Explain in detail about professional rights and employee rights.

b) Exemplify engineers as managers.

MODULE V

19.a) Evaluate the technology transfer and appropriate technology.

b) Explain about computer and internet ethics.

(8+6 = 14 marks)

Or

20. a) Investigate the causes and effects of acid rain with a case study.

b) Conclude the features of ecocentric and biocentric ethics.

(8+6 = 14 marks)

Syllabus

Module 1 – Human Values.

Morals, values and Ethics – Integrity- Academic integrity-Work Ethics- Service Learning- Civic Virtue- Respect for others- Living peacefully- Caring and Sharing- Honestly- courage-Cooperation commitment- Empathy-Self Confidence -Social Expectations.

Module 2 - Engineering Ethics & Professionalism.

Senses of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy – Kohlberg's theory- Gilligan's theory- Consensus and Controversy-Profession and Professionalism- Models of professional roles-Theories about right action –Self interest-Customs and Religion- Uses of Ethical Theories.

Module 3- Engineering as social Experimentation.

Engineering as Experimentation – Engineers as responsible Experimenters- Codes of Ethics- Plagiarism- A balanced outlook on law - Challenges case study- Bhopal gas tragedy.

Module 4- Responsibilities and Rights.

Collegiality and loyalty – Managing conflict- Respect for authority- Collective bargaining- Confidentiality- Role of confidentiality in moral integrity-Conflicts of interest- Occupational crime- Professional rights- Employee right- IPR Discrimination.

Module 5- Global Ethical Issues.

Multinational Corporations- Environmental Ethics- Business Ethics- Computer Ethics -Role in Technological Development-Engineers as Managers- Consulting Engineers- Engineers as Expert witnesses and advisors-Moral leadership.

Text Book

1. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.
2. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited ,New Delhi,2006.

Reference Books

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi,2014.
2. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics- Concepts and cases, Wadsworth Thompson Learning, United states,2005.
4. <http://www.slideword.org/slidestag.aspx/human-values-and-Professional-ethics>.

Course Contents and Lecture Schedule

SL.No	Topic	No. of Lectures 25
1	Module 1 – Human Values.	
1.1	Morals, values and Ethics, Integrity, Academic Integrity, Work Ethics	1
1.2	Service Learning, Civic Virtue, Respect for others, Living peacefully	1
1.3	Caring and Sharing, Honesty, Courage, Co-operation commitment	2
1.4	Empathy, Self Confidence, Social Expectations	1
2	Module 2- Engineering Ethics & Professionalism.	
2.1	Senses of Engineering Ethics, Variety of moral issues, Types of inquiry	1
2.2	Moral dilemmas, Moral Autonomy, Kohlberg's theory	1
2.3	Gilligan's theory, Consensus and Controversy, Profession & Professionalism, Models of professional roles, Theories about right action	2
2.4	Self interest-Customs and Religion, Uses of Ethical Theories	1
3	Module 3- Engineering as social Experimentation.	
3.1	Engineering as Experimentation, Engineers as responsible Experimenters	1
3.2	Codes of Ethics, Plagiarism, A balanced outlook on law	2
3.3	Challenger case study, Bhopal gas tragedy	2
4	Module 4- Responsibilities and Rights.	
4.1	Collegiality and loyalty, Managing conflict, Respect for authority	1
4.2	Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Conflicts of interest	2
4.3	Occupational crime, Professional rights, Employee right, IPR Discrimination	2
5	Module 5- Global Ethical Issues.	
5.1	Multinational Corporations, Environmental Ethics, Business Ethics, Computer Ethics	2
5.2	Role in Technological Development, Moral leadership	1
5.3	Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors	2

CODE MCN202	COURSE NAME CONSTITUTION OF INDIA	CATEGORY	L	T	P	CREDIT
			2	0	0	NIL

Preamble:

The study of their own country constitution and studying the importance environment as well as understanding their own human rights help the students to concentrate on their day to day discipline. It also gives the knowledge and strength to face the society and people.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Explain the background of the present constitution of India and features.
CO 2	Utilize the fundamental rights and duties.
CO 3	Understand the working of the union executive, parliament and judiciary.
CO 4	Understand the working of the state executive, legislature and judiciary.
CO 5	Utilize the special provisions and statutory institutions.
CO 6	Show national and patriotic spirit as responsible citizens of the country

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2	2	2		2		
CO 2						3	3	3		3		
CO 3						3	2	3		3		
CO 4						3	2	3		3		
CO 5						3	2	3		3		
CO 6						3	3	3		2		

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			

Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions**Course Outcome 1 (CO1):**

- 1 Discuss the historical background of the Indian constitution.
- 2 Explain the salient features of the Indian constitution.
- 3 Discuss the importance of preamble in the implementation of constitution.

Course Outcome 2 (CO2)

- 1 What are fundamental rights ? Examine each of them.
- 2 Examine the scope of freedom of speech and expression underlying the constitution.
- 3 The thumb impression of an accused is taken by the police against his will. He contends that this is a violation of his rights under Art 20(3) of the constitution. Decide.

Course Outcome 3(CO3):

- 1 Explain the powers of the President to suspend the fundamental rights during emergency.

- 2 Explain the salient features of appeal by special leave.
3. List the constitutional powers of President.

Course Outcome 4 (CO4):

- 1 Discuss the constitutional powers of Governor.
- 2 Examine the writ jurisdiction of High court.
- 3 Discuss the qualification and disqualification of membership of state legislature.

Course Outcome 5 (CO5):

- 1 Discuss the duties and powers of comptroller of auditor general.
- 2 Discuss the proclamation of emergency.
- 3 A state levies tax on motor vehicles used in the state, for the purpose of maintaining roads in the state. X challenges the levy of the tax on the ground that it violates the freedom of interstate commerce guaranteed under Art 301. Decide.

Course Outcome 6 (CO6):

- 1 Explain the advantages of citizenship.
- 2 List the important principles contained in the directive principles of state policy.
- 3 Discuss the various aspects contained in the preamble of the constitution

Model Question paper

PART A

(Answer all questions. Each question carries 3 marks)

- 1 Define and explain the term constitution.
- 2 Explain the need and importance of Preamble.
- 3 What is directive principle of state policy?
- 4 Define the State.
- 5 List the functions of Attorney general of India.

- 6 Explain the review power of Supreme court.
- 7 List the qualifications of Governor.
- 8 Explain the term and removal of Judges in High court.
- 9 Explain the powers of public service commission.
- 10 List three types of emergency under Indian constitution.

(10X3=30marks)

PART B

(Answer on question from each module. Each question carries 14 marks)

Module 1

- 11 Discuss the various methods of acquiring Indian citizenship.
- 12 Examine the salient features of the Indian constitution.

Module 2

- 13 A high court passes a judgement against X. X desires to file a writ petition in the supreme court under Art32, on the ground that the judgement violates his fundamental rights.

Advise him whether he can do so.

- 14 What is meant by directive principles of State policy? List the directives.

Module3

- 15 Describe the procedure of election and removal of the President of India.
- 16 Supreme court may in its discretion grant special leave to appeal. Examine the situation.

Module 4

- 17 Discuss the powers of Governor.
- 18 X filed a writ petition under Art 226 which was dismissed. Subsequently, he filed a writ petition under Art 32 of the constitution, seeking the same remedy. The Government argued that the writ petition should be dismissed, on the ground of res judicata. Decide.

Module 5

19 Examine the scope of the financial relations between the union and the states.

20 Discuss the effects of proclamation of emergency.

(14X5=70marks)

Syllabus

Module 1 Definition, historical back ground, features, preamble, territory, citizenship.

Module 2 State, fundamental rights, directive principles, duties.

Module 3 The machinery of the union government.

Module 4 Government machinery in the states

Module 5 The federal system, Statutory Institutions, miscellaneous provisions.

Text Books

1 D D Basu, Introduction to the constitution of India, Lexis Nexis, New Delhi, 24e, 2019

2 PM Bhakshi, The constitution of India, Universal Law, 14e, 2017

Reference Books

1 Ministry of law and justice, The constitution of India, Govt of India, New Delhi, 2019.

2 JN Pandey, The constitutional law of India, Central Law agency, Allahabad, 51e, 2019

3 MV Pylee, India's Constitution, S Chand and company, New Delhi, 16e, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Module 1	
1.1	Definition of constitution, historical back ground, salient features of the constitution.	1
1.2	Preamble of the constitution, union and its territory.	1
1.3	Meaning of citizenship, types, termination of citizenship.	2
2	Module 2	
2.1	Definition of state, fundamental rights, general nature, classification, right to equality ,right to freedom , right against exploitation	2

2.2	Right to freedom of religion, cultural and educational rights, right to constitutional remedies. Protection in respect of conviction for offences.	2
2.3	Directive principles of state policy, classification of directives, fundamental duties.	2
3	Module 3	
3.1	The Union executive, the President, the vice President, the council of ministers, the Prime minister, Attorney-General, functions.	2
3.2	The parliament, composition, Rajya sabha, Lok sabha, qualification and disqualification of membership, functions of parliament.	2
3.3	Union judiciary, the supreme court, jurisdiction, appeal by special leave.	1
4	Module 4	
4.1	The State executive, the Governor, the council of ministers, the Chief minister, advocate general, union Territories.	2
4.2	The State Legislature, composition, qualification and disqualification of membership, functions.	2
4.3	The state judiciary, the high court, jurisdiction, writs jurisdiction.	1
5	Module 5	
5.1	Relations between the Union and the States, legislative relation, administrative relation, financial Relations, Inter State council, finance commission.	1
5.2	Emergency provision, freedom of trade commerce and inter course, comptroller and auditor general of India, public Services, public service commission, administrative Tribunals.	2
5.3	Official language, elections, special provisions relating to certain classes, amendment of the Constitution.	2

RAL 202	MANUFACTURING AND PROTOTYPING (LAB)	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

COURSE OUTCOMES

CO1. Get hands on various manual production machines and processes.

CO2. Identify the various operations and the required machines and attachments for prototyping the robotic components.

CO3. Preparing the CNC machines and programming them for machining robotic components.

CO4. Use CAD/CAM for generating CNC code for production machines to realise parts.

CO5. Understand the properties of 3D printed parts and use the rapid prototyping effectively to make prototypes.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3											3
CO 2	3											3
CO 3	3				2							3
CO 4	3	2	2		3							3
CO 5	3	2	2		3							3

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance	:	15 marks
Continuous Assessment	:	30 marks
Internal Test (Immediately before the second series test)	:	30 marks

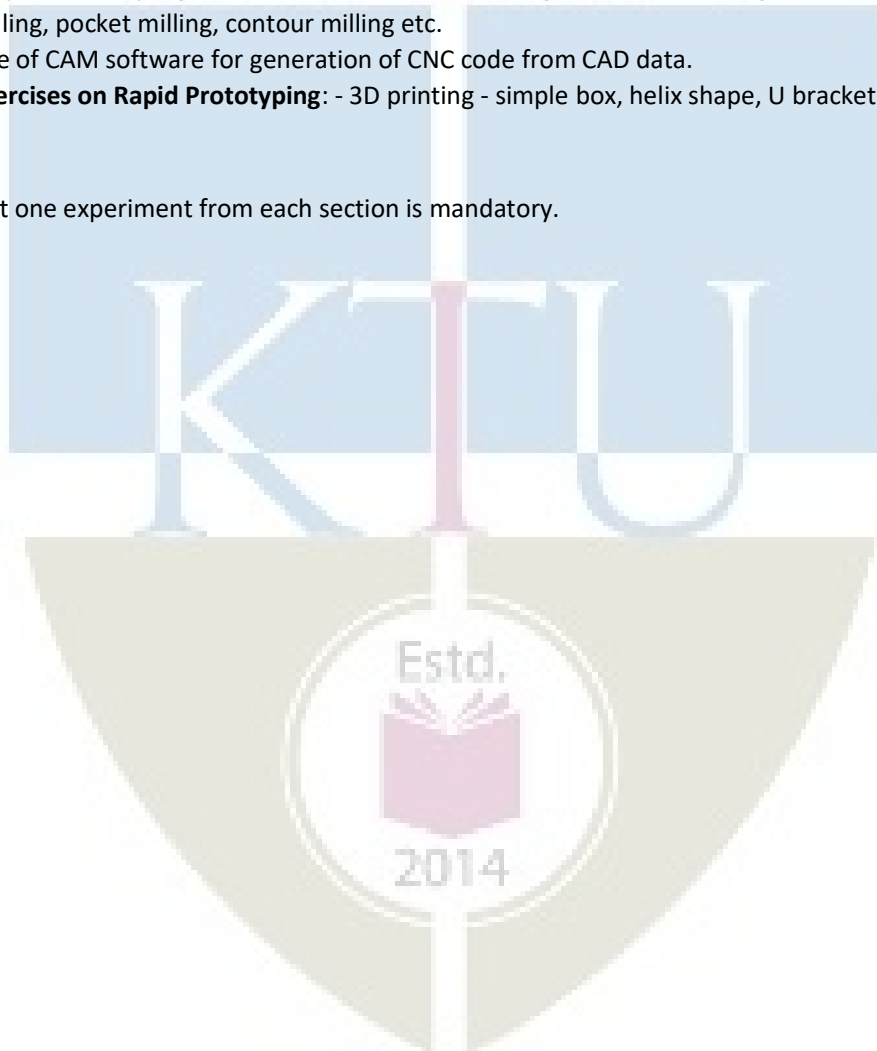
End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work (selection of tools, specifying machine settings etc)	: 10 Marks
(b) Implementing the work/Conducting the experiment	: 25 Marks
(c) Result (accuracy, surface finish, completion of the part)	: 15 Marks
(d) Viva voce	: 20 Marks
(e) Record	: 5 Marks

LIST OF EXPERIMENTS

1. **Exercises on Milling Machine:** - Face milling, end milling – spur and helical gear cutting – milling of key ways, T slot cutting, Inspection of the work using measuring instruments
2. **Exercises on Centre Lathe:** - Facing, plain turning, step turning, taper turning and form turning, groove cutting, knurling and chamfering, multi-start thread, square thread and internal thread, Inspection of the work using measuring instruments
3. **Exercises on Grinding machine:** - Exercise on surface grinding, cylindrical grinding and tool grinding, Inspection of the work using measuring instruments
4. **Exercises on Welding:** - Exercises on arc and gas welding - butt welding and lap welding of M.S. sheets.
5. Preparation of program and Exercise on **CNC lathe including simulation:** -turning, step turning, taper turning, thread cutting, circular interpolation etc.
6. Preparation of program and Exercise on **CNC milling machine including simulation:** - surface milling, pocket milling, contour milling etc.
7. Use of CAM software for generation of CNC code from CAD data.
8. **Exercises on Rapid Prototyping:** - 3D printing - simple box, helix shape, U bracket

NB: At least one experiment from each section is mandatory.



RAL 204	MICROCONTROLLERS AND EMBEDDED SYSTEMS LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Course Outcomes: After the completion of the course the student will be able to

CO 1	Program and test a microcontroller system.
CO 2	Interface a microcontroller system to user controls and other electronic systems.
CO 3	Design embedded systems for the required applications

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3			2			2	2	2	3
CO 2	3	3	3			2			2	2	2	3
CO 3	3	3	3			2			2	2	2	3

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance	:	15 marks
Continuous Assessment	:	30 marks
Internal Test (Immediately before the second series test) :		30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work	: 15 Marks
(b) Implementing the work/Conducting the experiment	: 10 Marks
(c) Performance, result and inference (usage of equipments and trouble shooting)	: 25 Marks
(d) Viva voce	: 20 Marks
(e) Record	: 5 Marks

LIST OF EXPERIMENTS

Part A: 8051 Assembly language Programming

The programs shall be written in assembly language. The interfacing modules may be developed using Embedded C.

(5 experiments mandatory)

- Arithmetic Operations-32 bit addition, subtraction
- Data Transfer-
- Sorting
- Multiplication by shift and add method
- Time delay generation and relay interface.
- ADC interface.
- DAC interface with wave form generation
- Display (LED/Seven segments/LCD) and keyboard interface.
- Stepper motor and DC motor interface

Part B: Arduino Programming using Arduino IDE

(5 experiments mandatory)

- Toggle the ON/OFF status of an LED with a Switch
- Turn a Relay ON and OFF
- Control the speed of a DC Motor
- Interfacing Stepper Motor
- Serial Communication Program
- Interfacing Seven Segment Display/ Alphanumeric Display
- ADC operation of Arduino using Potentiometer and Display

Part c: Project

Mini Project using at least one sensor and one actuator

Reference Books

1. Muhammad Ali Mazidi, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson, 2nd Edition, 2007.
2. Michael McRoberts, "Beginning Arduino", Apress, 1e, 2011
3. Kenneth Ayala, "The 8051 Microcontroller", Cengage Learning, 3e, 2012
4. Raj Kamal, "Embedded Systems Architecture, programming and Design", Tata McGraw-Hill, 3e, 2013