INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad-500043

MECHANICAL ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**MATHEMATICAL METHODS IN ENGINEERING**					
Course Code	BCCB02					
Programme	M.Tech					
Semester	I	ME				
Course Type	Foundation					
Regulation	**IARE - R18**					
Course Structure	**Theory**			**Practical**		
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**	
	3	-	3	-	-	
Chief Coordinator	Dr. J Suresh Goud, Associate Professor, FE					

COURSE OBJECTIVES:

The course should enable the students to:	
I	Develop a basic understanding of a range of mathematics tools with emphasis on engineering applications.
II	Solve problems with techniques from advanced linear algebra, ordinary differential equations and multivariable differentiation.
III	Develop skills to think quantitatively and analyze problems critically.

COURSE OUTCOMES (COs):

CO 1	Describe the basic concepts of probability, discrete, continuous random variables and determine probability distribution, sampling distribution of statistics like t, F and chi-square.
CO 2	Understand the foundation for hypothesis testing to predict the significance difference in the sample means and the use of ANOVA technique.
CO 3	Determine Ordinary linear differential equations solvable by nonlinear ODE’s.
CO 4	Explore First and second order partial differential equations.
CO 5	Analyze the solution methods for wave equation, D’Alembert solution, and potential equation, properties of harmonic functions, maximum principle, and solution by variable separation method.

COURSE LEARNING OTCOMES (CLOs):

BCCB02.01	Describe the basic concepts of probability, discrete and continuous random variables
BCCB02.02	Determine the probability distribution to find mean and variance.
BCCB02.03	Discuss the concept of sampling distribution of statistics like t, F and chi-square.
BCCB02.04	Understand the foundation for hypothesis testing.
BCCB02.05	Apply testing of hypothesis to predict the significance difference in the sample means.
BCCB02.06	Understand the assumptions involved in the use of ANOVA technique.
BCCB02.07	Solve differential equation using single step method.
BCCB02.08	Solve differential equation using multi step methods.
BCCB02.09	Understand the concept of non- linear ordinary differential equations.
BCCB02.10	Understand partial differential equation for solving linear equations.
BCCB02.11	Solving the heat equation in subject to boundary conditions.
BCCB02.12	Solving the wave equation in subject to boundary conditions.
BCCB02.13	Understand the conditions for a complex variable to be analytic and entire function.
BCCB02.14	Understand the concept of harmonic functions.
BCCB02.15	Analyze the concept of partial differential equations by variable separation method.

TUTORIAL QUESTION BANK

UNIT- I				
INTRODUCTION TO PROBABILITY				
Part - A (Short Answer Questions)				
S No	**QUESTIONS**	**Blooms Taxonomy Level**	**Course Outcomes**	**Course Learning Outcomes (CLOs)**
1	Define random variable. Write a short note on discrete and continuous random variables with a suitable example.	Remember	CO 1	BCCB02.01
2	Out of 24 mangoes, 6 mangoes are rotten. If we draw two mangoes. Obtain probability distribution of number of rotten mangoes that can be drawn.	Understand	CO 1	BCCB02.01
3	20% of items produced from a goods factory are defective. If we choose 5 items randomly then find the probability of non defective item.	Understand	CO 1	BCCB02.02
4	The mean and variance of a binomial distribution are 4 and 4/3 respectively. Then find P(x=1).	Understand	CO 1	BCCB02.02
5	In eight throws of a die 5 or 6 is considered a success. Find the mean number of success.	Understand	CO 1	BCCB02.02
6	The probability if no misprint in a book is e^{-4}. Find probability that a page of book contains exactly two misprints.	Understand	CO 1	BCCB02.02
7	Draft the recurrence relation for the poisson distribution.	Remember	CO 1	BCCB02.02
8	If a bank received on the average 6 bad cheques per day, find the probability that it will receive 4 bad cheques on any given day.	Understand	CO 1	BCCB02.02
9	Explain about Normal distribution.	Remember	CO 1	BCCB02.02
10	If X is normally distributed with mean 2 and variance 0.1, then find P ($\lvert x-2\rvert \geq 0.01$)?	Understand	CO 1	BCCB02.02
11	If the probability of a defective bolt is 0.2, find (i) mean (ii) standard deviation for the bolts in a total of 400.	Understand	CO 1	BCCB02.02
12	If $\bar{x}$ =47.5, $\mu = 42.1, s = 8.4, n = 24$ then find t.	Understand	CO 1	BCCB02.03
13	What is the test statistic for t test for single mean and difference of means?	Remember	CO 1	BCCB02.03
14	Define degree of freedom. Find $t_{0.05}$ when 16 degrees of freedom.	Remember	CO 1	BCCB02.03
15	Distinguish between t test for difference of means and F test.	Remember	CO 1	BCCB02.03
16	What is the test statistic for F test? Find $F_{0.99}$ with (28, 12) degrees of freedom.	Remember	CO 1	BCCB02.03
17	Write the formulae for sample mean, sample variance and sample standard deviation.	Remember	CO 1	BCCB02.03
18	What is the degree of freedom for chi square test in case of contingency table of order 4x3?	Remember	CO 1	BCCB02.03
19	What is the test statistic for chi square test?	Remember	CO 1	BCCB02.03
20	Find $\chi^2_{0.05}$ at 9 degrees of freedom.	Understand	CO 1	BCCB02.03
Part - B (Long Answer Questions)				
1	A random variable X has the following probability function. X: 4, 5, 6, 8 P(X): 0.1, 0.3, 0.4, 0.2 Determine (i) Expectation (ii) variance (iii) Standard deviation.	Understand	CO 1	BCCB02.01
2	A continuous random variable has the probability density function $f(x) = \begin{cases} kxe^{-\lambda x}, \; for\; x \geq 0, \lambda > 0 \\ 0, otherwise \end{cases}$ Determine (i) k (ii) Mean (iii) Variance.	Understand	CO 1	BCCB02.01
3	Out of 20 tape recorders 5 are defective. Find the standard deviation of defective in the sample of 10 randomly chosen tape recorders. Find (i) P(X=0) (ii) P(X=1) (iii) P(X=2) (iv) P (1<X<4).	Understand	CO 1	BCCB02.02
4	Out of 800 families with 5 children each, how many would you expect to have (i)3 boys (ii)5girls (iii)either 2 or 3 boys ? Assume equal probabilities for boys and girls.	Understand	CO 1	BCCB02.02

<table>
<tr><td>5</td><td>4 coins are tossed 160 times. Fit the Binomial distribution of getting number of heads.</td><td>Understand</td><td>CO 1</td><td>BCCB02.02</td></tr>
<tr><td>6</td><td>A car-hire firm has two cars which it hires out day by day. The number of demands for a car o n each day is distributed as a Poisson distribution with mean 1.5. Calculate the proportion of days (i) on which there is no demand (ii) on which demand is refused.</td><td>Understand</td><td>CO 1</td><td>BCCB02.02</td></tr>
<tr><td>7</td><td>The average number of phone calls per minute coming into a switch board between 2 P.M. and 4 P.M. is 2.5. Determine the probability that during one particular minute (i) 4 or fewer calls (ii) more than 6 calls.</td><td>Understand</td><td>CO 1</td><td>BCCB02.02</td></tr>
<tr><td>8</td><td>If a Poisson distribution is such that $P(X=1)=\frac{3}{2}P(X=3)$ then find (i) $P(X\geq 1)$ (ii) $P(X\leq 3)$ (iii) $P(2\leq X\leq 5)$.</td><td>Understand</td><td>CO 1</td><td>BCCB02.02</td></tr>
<tr><td>9</td><td>If X is a normal variate with mean 30 and standard deviation 5. Find the probabilities that i) P $(26 \leq X \leq 40)$ ii) P($X \geq 45$).</td><td>Understand</td><td>CO 1</td><td>BCCB02.02</td></tr>
<tr><td>10</td><td>In a Normal distribution, 7% of the item are under 35 and 89% are under 63. Find the mean and standard deviation of the distribution.</td><td>Understand</td><td>CO 1</td><td>BCCB02.02</td></tr>
<tr><td>11</td><td>1000 students have written an examination with the mean of test is 35 and standard deviation is 5. Assuming the distribution to be normal find i) How many students marks like between 25 and 40? ii) How many students get more than 40? iii) How many students get below 20? iv) How many students get more than 50.</td><td>Understand</td><td>CO 1</td><td>BCCB02.02</td></tr>
<tr><td>12</td><td>Producer of ‘gutkha’ claims that the nicotine content in his ‘gutkha’ on the average is 0.83 mg. can this claim be accepted if a random sample of 8 ‘gutkhas’ of this type have the nicotine contents of 2.0,1.7,2.1, 1.9,2.2, 2.1, 2.0,1.6 mg.</td><td>Understand</td><td>CO 1</td><td>BCCB02.03</td></tr>
<tr><td>13</td><td>The means of two random samples of sizes 9,7 are 196.42 and 198.82.the sum of deviations from their respective means are 26.94,18.73.can the samples be consid have been the same population?</td><td>Understand</td><td>CO 1</td><td>BCCB02.03</td></tr>
<tr><td>14</td><td>Two independent samples of items are given respectively had the following values.
<table>
<tr><td>Sample I</td><td>11</td><td>11</td><td>13</td><td>11</td><td>15</td><td>9</td><td>12</td><td>14</td></tr>
<tr><td>Sample II</td><td>9</td><td>11</td><td>10</td><td>13</td><td>9</td><td>8</td><td>10</td><td>-</td></tr>
</table>
Test whether there is any significant difference between their means?</td><td>Understand</td><td>CO 1</td><td>BCCB02.03</td></tr>
<tr><td>15</td><td>In one sample of 8 observations the sum of squares of deviations of the sample values from the sample mean was 84.4 and another sample of 10 observations it was 102.6 .test whether there is any significant difference between two sample variances at at 5% level of significance.</td><td>Understand</td><td>CO 1</td><td>BCCB02.03</td></tr>
<tr><td>16</td><td>Time taken by workers in performing a job by method 1 and method 2 is given below.
<table>
<tr><td>Method 1</td><td>20</td><td>16</td><td>27</td><td>23</td><td>22</td><td>26</td><td>-</td></tr>
<tr><td>Method 2</td><td>27</td><td>33</td><td>42</td><td>35</td><td>32</td><td>34</td><td>38</td></tr>
</table>
Does the data show that variances of time distribution from population which these samples are drawn do not differ significantly?</td><td>Understand</td><td>CO 1</td><td>BCCB02.03</td></tr>
<tr><td>17</td><td>The following random samples are measurements of the heat-producing capacity (in millions of calories per ton) of speciments of coal from two mines:
<table>
<tr><td>Mine 1</td><td>8,260</td><td>8,130</td><td>8,350</td><td>8,070</td><td>8,340</td><td>…</td></tr>
<tr><td>Mine 2</td><td>7,950</td><td>1,890</td><td>7,900</td><td>8,140</td><td>7,920</td><td>7,840</td></tr>
</table>
Use the 0.05 level of significance to test whether it is reasonable to assume that the variances of the two populations are equal.</td><td>Understand</td><td>CO 1</td><td>BCCB02.03</td></tr>
<tr><td>18</td><td>The no. of automobile accidents per week in a certain area as follows: 12,8,20,2,14,10,15,6,9,4. Are these frequencies in agreement with the belief that accidents were same in the during last 10 weeks.</td><td>Understand</td><td>CO 1</td><td>BCCB02.03</td></tr>
</table>

<table>
<tr><td>19</td><td>200 digits were choosen at random from set of tables the frequency of the digits are
<table>
<tr><td>digit</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td>frequency</td><td>18</td><td>19</td><td>23</td><td>21</td><td>16</td><td>25</td><td>22</td><td>20</td><td>21</td><td>15</td></tr>
</table>
Use chi square test to asset the correctness of the hypothesis that the digits are distributed in equal number in the table</td><td>Understand</td><td>CO 1</td><td>BCCB02.03</td></tr>
<tr><td>20</td><td>The following table gives the classification of 100 workers according to gender and nature of work. Test whether the nature of work is independent of the gender of the worker.
<table>
<tr><td></td><td>Stable</td><td>Unstable</td><td>Total</td></tr>
<tr><td>Male</td><td>40</td><td>20</td><td>60</td></tr>
<tr><td>Female</td><td>10</td><td>30</td><td>40</td></tr>
<tr><td>Total</td><td>50</td><td>50</td><td>100</td></tr>
</table></td><td>Understand</td><td>CO 1</td><td>BCCB02.03</td></tr>
<tr><td colspan="5">Part - C (Problem Solving and Critical Thinking Questions)</td></tr>
<tr><td>1</td><td>If f(x) =k $e^{-|x|}$ is probability density function in the interval, $-\infty < x < \infty$, then find i) k ii) Mean iii) Variance iv) P(0<x<4).</td><td>Understand</td><td>CO 1</td><td>BCCB02.01</td></tr>
<tr><td>2</td><td>A discrete random variable X has the following probability distribution
<table>
<tr><td>X</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr>
<tr><td>P(X=x)</td><td>2k</td><td>4k</td><td>6k</td><td>8k</td><td>10k</td><td>12k</td><td>14k</td><td>4k</td></tr>
</table>
Find (i) k (ii) p(X<3) (iii) $p(X \geq 5)$</td><td>Understand</td><td>CO 1</td><td>BCCB02.01</td></tr>
<tr><td>3</td><td>The probability that a man hitting a target is 1/3. If he fires 5 times , determine the probability that he fires
(i) At most 3 times (ii) At least 2 times</td><td>Understand</td><td>CO 1</td><td>BCCB02.02</td></tr>
<tr><td>4</td><td>The marks obtained in mathematics by 1000 students are normally distributed with mean 78% and standard deviation 11%. Determine
(i)How many students got marks above 90% marks
(ii)What was the highest mark obtained by the lowest 10% of the students
(iii)Within what limits did the middle of 90% of the student lie.</td><td>Understand</td><td>CO 1</td><td>BCCB02.02</td></tr>
<tr><td>5</td><td>Average number of accidents on any day on a national highway is 1.8. Determine the probability that the number of accidents is (i) at least one (ii) at most one.</td><td>Understand</td><td>CO 1</td><td>BCCB02.02</td></tr>
<tr><td>6</td><td>The life of electronic tubes of a certain types may be assumed to be normal distributed with mean 155 hours and standard deviation 19 hours. Determine the probability that the life of a randomly chosen tube is
(i) between 136 hours and 174 hours.
(ii) less than 117 hours
(iii) will be more than 195 hours</td><td>Understand</td><td>CO 1</td><td>BCCB02.02</td></tr>
<tr><td>7</td><td>A mechanist making engine parts with axle diameters of 0.700 inch. A random sample of 10 parts shows a mean diameter of 0.742 inch with a S.D of 0.040 inch. Compute the statistic you would use to test whether the work is meeting the specifications.</td><td>Understand</td><td>CO 1</td><td>BCCB02.03</td></tr>
<tr><td>8</td><td>Pumpkins were grown under two experimental conditions. Two random samples of 11 and 9 pumpkins. the sample standard deviation of their weights as 0.8 and 0.5 respectively. Assuming that the weight distributions are normal, test hypothesis that the true variances are equal.</td><td>Understand</td><td>CO 1</td><td>BCCB02.03</td></tr>
<tr><td>9</td><td>A survey of 240 families with 4 children each revealed the following distribution.
<table>
<tr><td>Male Births</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>No of families</td><td>10</td><td>55</td><td>105</td><td>58</td><td>12</td></tr>
</table>
Test whether the male and female births are equally popular.</td><td>Understand</td><td>CO 1</td><td>BCCB02.03</td></tr>
</table>

10	In an investigation on the machine performance, the following results are obtained. <table><tr><td></td><td>No.of units inspected</td><td>No.of defective</td></tr><tr><td>Machine1</td><td>375</td><td>17</td></tr><tr><td>Machine2</td><td>450</td><td>22</td></tr></table>	Understand	CO 1	BCCB02.03
	UNIT-II			
	TESTING OF STATISTICAL HYPOTHESIS			
	Part – A (Short Answer Questions)			
1	Distinguish between large and small samples with example.	Remember	CO 2	BCCB02.04
2	In a manufacturing company out of 100 goods 25 are top quality. find sample proportion.	Understand	CO 2	BCCB02.05
3	Construct the confidence interval for single mean if mean of sample size of 400 is 40, standard deviation is 10.	Understand	CO 2	BCCB02.05
4	Construct the confidence interval for single proportion if 18 goods are defective from a sample of 200 goods.	Understand	CO 2	BCCB02.05
5	Define sample proportion	Remember	CO 2	BCCB02.05
6	Define ANOVA.	Remember	CO 2	BCCB02.06
7	Explain ANOVA one - way classification.	Remember	CO 2	BCCB02.06
8	Define large sample.	Remember	CO 2	BCCB02.05
9	Write the test statistic for difference of means in large samples	Remember	CO 2	BCCB02.05
10	Write the test statistic for difference of proportions in large samples	Remember	CO 2	BCCB02.05
11	find the confidence interval for mean if mean of sample size of 144 is 150, standard deviation is 2.	Understand	CO 2	BCCB02.05
12	What is the probability of type-I error.	Remember	CO 2	BCCB02.04
13	Explain ANOVA two - way classification.	Understand	CO 2	BCCB02.06
14	In a random sample of 125 coca cola drinkers 75 said they prefer thumsup to pepsi. Test the null hypothesis P=0.5 against alternative hypothesis P>0.5.	Understand	CO 2	BCCB02.05
15	Write the procedure of test of hypothesis	Remember	CO 2	BCCB02.04
16	Define one tailed and two tailed test.	Remember	CO 2	BCCB02.04
17	In a random sample of 225 coca cola drinkers 80 said they prefer pepsi to fanta. Test the null hypothesis P=0.5 against alternative hypothesis P>0.5	Understand	CO 2	BCCB02.05
18	Define critical region or region of rejection.	Remember	CO 2	BCCB02.04
19	Define critical value or significant value	Remember	CO 2	BCCB02.04
20	How many types of errors in talking a decision about null hypothesis.	Remember	CO 2	BCCB02.04
	Part - B (Long Answer Questions)			
1	The means of two large samples of sizes 1000 and 2000 members are 67.5 inches and 68.0 inches respectively. Can the samples be regarded as drawn from the same population of S.D 2.5 inches	Understand	CO 2	BCCB02.05
2	An ambulance service claims that it takes on the average 8.9 minutes to reach its destination In emergency calls. To check on this claim the agency which issues license to Ambulance service has then timed on fifty emergency calls getting a mean of 9.2 minutes with 1.6 minutes. What can they conclude at 5% level of significance?	Understand	CO 2	BCCB02.05
3	Experience had shown that 20% of a manufactured product is of the top quality. In one day's production of 400 articles only 50 are of top quality Test the hypothesis at 0.05 level.	Understand	CO 2	BCCB02.05
4	According to norms established for a mechanical aptitude test persons who are 18 years have an average weight of 73.2 with S.D 8.6 if 40 randomly selected persons have average 76.7 test the hypothesis $H_0 : \mu =73.2$ agaiinst alternative hypothesis : $\mu >73.2$.	Understand	CO 2	BCCB02.05
5	A sample of 100 electric bulbs produced by manufacturer 'A' showed a mean life time of 1190 hrs and s .d. of 90 hrs A sample of 75 bulbs produced by manufacturer 'B' Showed a mean life time of 1230 hrs with s.d. of 120 hrs. Is there difference between the mean life times of the two brands at a significance level of 0.05	Understand	CO 2	BCCB02.05
6	In a random sample of 60 workers, the average time taken by them to get to work is 33.8 minutes with a standard deviation of 6.1 minutes .Can we reject the null	Understand	CO 2	BCCB02.05

<table>
<tr><td></td><td>hypothesis $\mu = 32.6$ minutes in favour of alternative null hypothesis
$\mu > 32.6$ at $\alpha = 0.05$ level of significance</td><td></td><td></td><td></td></tr>
<tr><td>7</td><td>On the basis of their total scores, 200 candidates of a civil service examination are divided into two groups; the first group is 30% and the remaining 70%. Consider the first question of the examination among the first group, 40 had the correct answer. Whereas among the second group, 80 had the correct answer. On the basis of these results, can one conclude that the first question is not good at discriminating ability of the type being examined here</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>8</td><td>A cigarette manufacturing firm claims that brand A line of cigarettes outsells its brand B by 8% .if it is found that 42 out of a sample of 200 smokers prefer brand A and 18 out of another sample of 100 smokers prefer brand B. Test whether 8% difference is a valid claim.</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>9</td><td>If 48 out of 400 persons in rural area possessed ‘cell’ phones while 120 out of 500 in urban Area. Can it be accepted that the proportion of ‘cell’ phones in the rural area and Urban area is same or not. Use 5% of level of significance</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>10</td><td>In an investigation on machine performance the following results are obtained
<table>
<tr><th>M/C</th><th>No. of units inspected</th><th>No. of defectives</th></tr>
<tr><td>Machine I</td><td>375</td><td>17</td></tr>
<tr><td>Machine II</td><td>450</td><td>22</td></tr>
</table>
Test whether there is any significance performance of two machines at $\alpha = 0.05$.</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>11</td><td>2. The nicotine in milligrams of two samples of tobacco were found to be as follows. Test the hypothesis for the difference between means at 0.05 level
<table>
<tr><td>Sample-A</td><td>24</td><td>27</td><td>26</td><td>23</td><td>25</td><td></td></tr>
<tr><td>Sample-B</td><td>29</td><td>30</td><td>30</td><td>31</td><td>24</td><td>36</td></tr>
</table></td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>12</td><td>Samples of students were drawn from two universities and from their weights in kilograms mean and S.D are calculated and shown below make a large sample test to the significance of difference between means.
<table>
<tr><th></th><th>MEAN</th><th>S.D</th><th>SAMPLE SIZE</th></tr>
<tr><td>University-A</td><td>55</td><td>10</td><td>400</td></tr>
<tr><td>University-B</td><td>57</td><td>15</td><td>100</td></tr>
</table></td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>13</td><td>In a big city 325 men out of 600 men were found to be smokers. Does this information support the conclusion that the majority of men in this city are smokers?</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>14</td><td>In a random sample 125 cool drinkers 68 said that they prefer thumsup to pepsi test the null hypothesis P=0.5 againist the alternative hypothesis P>0.5 at 5%level of significane</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>15</td><td>In a sample of 1000 people in Karnataka 540 are rice eaters and the rest are wheat eaters. Can we assume that both rice and wheat are equally popular in this state at 1% level of significance.</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>16</td><td>100 articles from a factory are examined and 10 are found to be defective. 500 similar articles from a second factory are found to be 15 defective. Test the significant difference between two proportions at 5% level.</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>17</td><td>Random sample of 400 men and 600 women were asked wether they would like to hava flyover near their residence .200 men and 325 women were in favour of proposal. Test the hypothesis that the proportion of men and women in favour of proposal are same at 5% level.</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>18</td><td>Two large populations are 30% and 25% respectively fair-haired people.Is the difference likely to be hidden in samples of 1200 and 900 respectively from the two populations.</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>19</td><td>A machine puts out of 16 imperfect articles in a sample of 500 articles after the machine is overhauled it puts out 3 imperfect articles in a sample of 100 articles. Has the machine improved?</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
</table>

<table>
<tr><td>20</td><td>Three different methods of teaching statistics are used on three groups of students. Random samples of size 5 are taken from each group and the results are shown below the grades are on a 10-point scale
<table>
<tr><th>Group A</th><th>Group B</th><th>Group C</th></tr>
<tr><td>7</td><td>3</td><td>4</td></tr>
<tr><td>6</td><td>6</td><td>7</td></tr>
<tr><td>7</td><td>5</td><td>7</td></tr>
<tr><td>7</td><td>4</td><td>4</td></tr>
<tr><td>8</td><td>7</td><td>8</td></tr>
</table>
Determine on the basis of the above data whether there is difference in the teaching methods</td><td>Understand</td><td>CO 2</td><td>BCCB02.06</td></tr>
<tr><td colspan="5">Part - C (Problem Solving and Critical Thinking Questions)</td></tr>
<tr><td>1</td><td>A sample of 900 members has mean of 3.4 and S.D of 2.61 is this sample has been taken from a large population mean 3.25 and S.D 2.61. Also calculate 95% confidence interval.</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>2</td><td>It is claimed that a random sample of 49 tyres has a mean life of 15200 kms this sample was taken from population whose mean is 15150 kms and S.D is 1200 km test 0.05 level of signinficant.</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>3</td><td>In 64 randomly selected hour production mean and S.D of production are 1.038 and 0.146 At 0.05 level of significant does this enable to reject the null hypothesis $\mu = 1$ againist alternative hypothesis : $\mu > 1$.</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>4</td><td>A trucking company rm suspects the claim that average life of certain tyres is at least 28000 miles to check the claim rm puts 40 of this tyres on its truck and gets a mean life time of 27463 miles with a S.D 1348 miles can claim be true.</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>5</td><td>The mean height of 50 male students who participated in sports is 68.2 inches with a S.D of 2.5. The mean height of male students who have not participated in sports is 67.2 inches with a S.D of 2.8. Test the hypothesis that the height of the students who participated in sports more than the students who have not participated in sports.</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>6</td><td>Studying the flow of traffic at two busy intersections between 4pm and 6pm to determine the possible need for turn signals. It was found that on 40 week days there were on the average 247.3 cars approaching the first intersection from the south which made left turn, while on 30 week days there were on the average 254.1 cars approaching the first intersection from the south made left turns . the corresponding samples S.DS are 15.2 and 12. Test the significant difference of two means at 5% level.</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>7</td><td>A manufacturer claims that at least 95% of the equipment which he supplied to a factory conformed to specifications. An examination of sample of 200 pieces of equipments received 18 were faulty test the claim at 0.05 level.</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>8</td><td>Among the items produced by a factory out of 500, 15 were defective. In another sample of 400, 20 were defective test the significant difference between two proportioins at 5% level.</td><td>Understand</td><td>CO 2</td><td>BCCB02.05</td></tr>
<tr><td>9</td><td>Marks obtained by students
<table>
<tr><th>Group A</th><th>Group B</th><th>Group C</th></tr>
<tr><td>16</td><td>15</td><td>15</td></tr>
<tr><td>17</td><td>15</td><td>14</td></tr>
<tr><td>13</td><td>13</td><td>13</td></tr>
<tr><td>18</td><td>17</td><td>14</td></tr>
</table>
Using ANOVA find out whether teaching methods had any effect on the students performance</td><td>Understand</td><td>CO 2</td><td>BCCB02.06</td></tr>
<tr><td>10</td><td>Three training methods were compared to see if they led to greater productivity after training. The productivity measures for individuals trained by different methods are as follows
<table>
<tr><td>Method 1</td><td>36</td><td>26</td><td>31</td><td>20</td><td>34</td><td>25</td></tr>
<tr><td>Method 2</td><td>40</td><td>29</td><td>38</td><td>32</td><td>39</td><td>34</td></tr>
<tr><td>Method 3</td><td>32</td><td>18</td><td>100</td><td>21</td><td>33</td><td>27</td></tr>
</table>
At the 0.05 level of significance, do the three training methods lead to difference levels of productivity?</td><td>Understand</td><td>CO 2</td><td>BCCB02.06</td></tr>
</table>

	UNIT -III			
	ORDINARY DIFFERENTIAL EQUATIONS			
	Part - A (Short Answer Questions)			
1	Explain merits and demerits of Taylor Series method.	Remember	CO 3	BAEB01.07
2	Write the third order Runge- Kutta method to find the numerical solutions of ordinary differential equation.	Understand	CO 3	BAEB01.08
3	Write the Modified Euler formula to find the numerical solutions of ordinary differential equation.	Remember	CO 3	BAEB01.08
4	Write the second order Runge- Kutta method to find the numerical solutions of ordinary differential equation.	Understand	CO 3	BAEB01.08
5	Define ordinary differential equation.	Remember	CO 3	BAEB01.09
6	Explain types of ordinary differential equations.	Remember	CO 3	BAEB01.09
7	Write short note on the methods of the numerical solution of ordinary differential equation.	Remember	CO 3	BAEB01.09
8	Explain single step methods.	Remember	CO 3	BAEB01.07
9	Write short note on step by step methods.	Understand	CO 3	BAEB01.08
10	Define initial value problems.	Remember	CO 3	BAEB01.09
11	Write short note on boundary value problems.	Understand	CO 3	BAEB01.09
12	Define mixed value problems.	Remember	CO 3	BAEB01.09
13	Explain Taylor series method.	Remember	CO 3	BAEB01.07
14	Distinguish between analytical solution and numerical solution.	Remember	CO 3	BAEB01.09
15	Explain merits and demerits of Runge-Kutta Method Series method.	Remember	CO 3	BAEB01.08
16	Write a short note on Euler’s method.	Remember	CO 3	BAEB01.08
17	Write the first order Runge- Kutta method to find the numerical solutions of ordinary differential equation.	Understand	CO 3	BAEB01.08
18	Explain fourth order Runge- Kutta method.	Remember	CO 3	BAEB01.08
19	Explain the advantaged of Runge- Kutta method over Taylor’s Series method.	Understand	CO 3	BAEB01.08
20	Define Adams-Bashforth- Moulton method.	Remember	CO 3	BAEB01.08
	Part – B (Long Answer Questions)			
1	By using Taylor’s series method find an approximate value of y at x = 0.2 for the differential equation $y' - 2y = 3e^x, y(0) = 0$.	Understand	CO 3	BAEB01.07
2	Using Euler’s method solve for x = 2 for $\frac{dy}{dx} = 3x^2 + 1$, y(1) = 2,taking step size (i) h = 0.5and (ii) h=0.25.	Analyze	CO 3	BAEB01.08
3	Solve by Euler’s method,$y^1 = x + y$, y(0) = 1 and find the value of y(0.3) taking step size h = 0.1. compare the result obtained by this method with the result obtained by analytical methods	Remember	CO 3	BAEB01.08
4	Using Runge-Kutta method of fourth order, find y(0.2)where $y' = y - x$, y(0)=2 , h = 0.2 .	Understand	CO 3	BAEB01.08
5	Apply the 4th order Runge-Kutta method to find an approximate value of y when x=1.2 in steps of 0.1,given that $y' = x^2 + y^2$,y(1)=1.5	Understand	CO 3	BAEB01.08
6	Solve $y^1 = x^2 - y$, y(0) = 1, using Taylor’s series method and compute y(0.1), y(0.2), y(0.3) and y(0.4) (correct to 4 decimal places).	Understand	CO 3	BAEB01.07
7	By using Euler’s method solve the differential equation from $y' + y = 0, y(0) = 1$, find y(0.04), taking step size h = 0.01 .	Analyze	CO 3	BAEB01.08
8	Using modified Euler’s method find the approximate value of x when $x = 0.3$ given differential equation $dy/dx = x + y \ and \ y(0) = 1$.	Understand	CO 3	BAEB01.08
9	Find $y(2.5)$ from the differential equation $\frac{dy}{dx} = \frac{x+y}{x}$, y(2)=2 , h = 0.25 using Runge-Kutta method of second order.	Analyze	CO 3	BAEB01.08
10	Estimate y(0.2), given $y' = 3x + \frac{y}{2}, y(0) = 1$by using Runge-Kutta method, taking h=0.1.	Remember	CO 3	BAEB01.08

11	Using Taylor's series method find an approximate value of y at x = 0.1 given y(0)=1 for the differential equation $y' = 3x + y^2$	Understand	CO 3	BAEB01.07
12	Using Euler's method solve for $y' = y^2 + x$,y(0)=1 find y(0.1) and y(0.2)	Understand	CO 3	BAEB01.08
13	Solve $y' = x + y$, given $y(1) = 0$. Find $y(1.1)$ and $y(1.2)$ by Tayor's series method.	Analyze	CO 3	BAEB01.08
14	Given the differential equation y^1=y-x, y(0)=2 find y(0.2) using R- K method take h=0.1.	Understand	CO 3	BAEB01.08
15	Find y(0.1) and y(0.2) using modified Euler's formula given differential equation dy/dx= x^2-y, y(0)=1	Understand	CO 3	BAEB01.08
16	Given $y' = x + \sin y, y(0) = 1$ compute $y(0.2)$ and $y(0.4)$ with h=0.2 using Euler's Modified method.	Understand	CO 3	BAEB01.08
17	Employ Taylor's method to obtain approximate value of $y(1.1)$ and $y(1.3)$, for the differential equation $y' = x.y^{\frac{1}{3}}, y(1) = 1$. Compare the num,erical solution obtained with exact solution.	Analyze	CO 3	BAEB01.08
18	Use Mile's predictor – corrector method to obtain the solution of the equation $y' = x - y^2$ at $x = 0.8$ given that $y(0) = 0, y(0.2) = 0.02, y(0.4) = 0.0795, y(0.6) = 0.1762.$	Understand	CO 3	BAEB01.08
19	Obtain the solution of $y' = x^2(1+y), y(1) = 1$ at $x = 1(0.1)1.2$ by any numerical method and estimate $x = 1.3$ by Adam's method.	Remember	CO 3	BAEB01.08
20	If $\frac{dy}{dx} = 2e^x y, y(0) = 2$ find $y(0.4)$ using Adam's predictor corrector formula by calculating $y(0.1), y(0.2)$ and $y(0.3)$ using Euler's Modified formula.	Understand	CO 3	BAEB01.08
	Part – C (Problem Solving and Critical Thinking)			
1	Compute $y(0.1)$ and $y(0.2)$ by Runge-Kutta method of fourth order for the differential equation $y' = xy + y^2, y(0) = 1.$	Understand	CO 3	BAEB01.08
2	Find $y(0.1)$, $y(0.2)$, $z(0.1)$, $z(0.2)$ given $\frac{dy}{dx} = x + z,\ \frac{dz}{dx} = x - y^2$ and $y(0) = 2.\ z(0) = 1$ by using Taylor's series method.	Analyze	CO 3	BAEB01.07
3	Find $y(0.1)$ and $y(0.2)$ by Runge-Kutta method of fourth order formula given that differential equation $\frac{dy}{dx} = x + x^2 y, y(0) = 1.$	Understand	CO 3	BAEB01.08
4	Solve first order differential equation $\frac{dy}{dx} = \frac{y-x}{y+x}$, y(0) = 1 and estimate y(0.1) using Euler's method(5 steps).	Analyze	CO 3	BAEB01.08
5	Using modified Euler's method to find y (0.2) and y (0.4) given differential equation$y' = y + e^x$, y(0) = 0.	Remember	CO 3	BAEB01.08
6	Given the differential equation $\frac{dy}{dx} = -xy^2$, y(0) = 2 . Compute y(0.2) in steps of 0.1 , using modified Euler's method.	Understand	CO 3	BAEB01.08
7	Find the solution of differential equation $\frac{dy}{dx}$ = x-y , y(0)=1 at x = 0.1 , 0.2 ,0.3 , 0.4 and 0.5 using modified Euler's method.	Understand	CO 3	BAEB01.08
8	Given $\frac{dy}{dx} + \frac{y}{x} = \frac{1}{x^2}$ at $x = 1.4$ given that $y(1) = 1, y(1.1) = 0.996, y(1.2) = 0.986, y(1.3) = 0.972.$ by Adams-	Analyze	CO 3	BAEB01.08

	Bashforth-Moulton method.			
9	Find the solution of $\frac{dy}{dx} = x - y$ at $x = 0.4$ subject to the condition $y = 1$ at $x = 0$ and $h = 0.1$ using Milne's method. Use Euler's modified method to evaluate $y(0.1), y(0.2)$ and $y(0.3)$.	Understand	CO 3	BAEB01.08
10	Solve the initial value problem $y' + y^2 = e^x, y(0) = 1$ from $x = 0$ at $x = 0.5$ taking $h = 0.1$ using Adams-Bashforth-Moulton method. Starting values may be taken from Runge-Kutta method.	Remember	CO 3	BAEB01.08
UNIT -IV				
PARTIAL DIFFERENTIAL EQUATIONS AND CONCEPTS IN SOLUTION TO BOUNDARY VALUE PROBLEMS				
Part – A (Short Answer Questions)				
1	Define order with reference to partial differential equation	Remember	CO 4	BAEB01.10
2	Form the partial differential equation by eliminate the arbitrary constants from $z = ax^3 + by^3$	Understand	CO 4	BAEB01.10
3	Form the partial differential equation by eliminating arbitrary function $z=f(x^2+ y^2)$	Analyze	CO 4	BAEB01.10
4	Solve the partial differential equation $p\sqrt{x} + q\sqrt{y} = \sqrt{z}$	Understand	CO 4	BAEB01.10
5	Write short note on complete integral with reference to nonlinear partial differential equation	Remember	CO 4	BAEB01.10
6	Define general integral with reference to nonlinear partial differential equation	Remember	CO 4	BAEB01.10
7	Solve the partial differential equation $p^2+ q^2= m^2$	Understand	CO 4	BAEB01.10
8	Solve the partial differential equation $z=px+qy+ p^2 q^2$	Understand	CO 4	BAEB01.10
9	Define degree with reference to partial differential equation	Remember	CO 4	BAEB01.10
10	Write the heat one dimension equation	Remember	CO 4	BAEB01.11
11	Eliminate the arbitrary constants from $z=(x^2+a)(y^2+b)$	Understand	CO 4	BAEB01.10
12	Form the partial differential equation by eliminating a and b from $\log(az-1) = x + ay + b$	Analyze	CO 4	BAEB01.10
13	Form the partial differential equation by eliminating the constants from $(x-a)^2 + (y-b)^2 = z^2 \cot^2 \alpha$ where α is a parameter.	Understand	CO 4	BAEB01.10
14	Define non-linear partial differential equation.	Remember	CO 4	BAEB01.10
15	Define particular integral with reference to nonlinear partial differential equation.	Remember	CO 4	BAEB01.10
16	Define singular integral with reference to nonlinear partial differential equation.	Remember	CO 4	BAEB01.10
17	Solve $p- x^2=q+ y^2$	Understand	CO 4	BAEB01.10
18	Solve the partial differential equation $x(y-z)p+y(z-x)q=z(x-y)$.	Understand	CO 4	BAEB01.10
19	Find a complete integral of $f=xpq+yq^2-1=0$.	Understand	CO 4	BAEB01.10
20	Find a complete integral of $f= (p^2+q^2)y-qz=0$	Understand	CO 4	BAEB01.10
Part – B (Long Answer Questions)				
1	Form the partial differential equation by eliminating arbitrary function from $f(x^2+ y^2+ z^2, z^2-2xy)=0$	Understand	CO 4	BAEB01.10
2	Solve the partial differential equation $p^2z^2 \sin^2 x + q^2z^2 \cos^2 y = 1$.	Understand	CO 4	BAEB01.10
3	Solve the partial differential equation $x^2p^2 + xpq = z^2$.	Understand	CO 4	BAEB01.10
4	Solve the partial differential equation $q^2 - p = y - x$.	Understand	CO 4	BAEB01.10
5	Find the temperature in a thin metal rod of length L, with both ends insulated and with initial temperature in the rod in $\sin\left(\frac{\pi x}{L}\right)$.	Analyze	CO 4	BAEB01.11
6	Form a partial differential equation by eliminating a, b, c from $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$.	Understand	CO 4	BAEB01.10
7	Evaluate the partial differential equation $(x^2 - yz)p + (y^2 - zx)q = z^2 - xy$	Understand	CO 4	BAEB01.10

8	Solve the partial differential equation $(z^2-2yz-y^2)p+(xy+zx)q=xy-zx.$	Analyze	CO 4	BAEB01.10
9	Solve the partial differential equation $(mz-ny)p+(nx-lz)q=(ly-mx)$.	Understand	CO 4	BAEB01.10
10	Evaluate the partial differential equation $y^2zp+x^2zq = xy^2$	Understand	CO 4	BAEB01.10
11	Solve the partial differential equation $z(p^2-q^2)=x-y$	Understand	CO 4	BAEB01.10
12	Find $u_{xx}=u_y+2u$ with $u(0,y)=0$ and $\frac{\partial u(0,y)}{\partial x}=1+e^{=3y}$.	Analyze	CO 4	BAEB01.11
13	Solve the partial differential equation $p-x^2=q+y^2$.	Understand	CO 4	BAEB01.10
14	Find the partial differential equation $q=px+p^2$.	Understand	CO 4	BAEB01.10
15	Evaluate the partial differential equation $z^2=pqxy.$	U Remember	CO 4	BAEB01.10
16	Solve the partial differential equation $z=p^2x+q^2y$	Understand	CO 4	BAEB01.10
17	Find the differential equation of all spheres whose centres lie on z-axis with a given radius r.	Understand	CO 4	BAEB01.10
18	Solve $y^3\frac{\partial z}{\partial x}+x^2\frac{\partial z}{\partial x}=0$	Understand	CO 4	BAEB01.11
19	Solve $\frac{\partial u}{\partial x}=2\frac{\partial u}{\partial t}+u$ where $u(x,0)=6e^{-3x}$	Analyze	CO 4	BAEB01.11
20	An insulated rod OA of length l with insulated sides, has initial temperature $u(x,0)$ for $0\le x\le l.$The ends are insulated at $t=0$. Find the subsequent temperature distribution.	Understand	CO 4	BAEB01.11
	Part – C (Problem Solving and Critical Thinking)			
1	Solve the partial differential equation $(x^2-y^2-yz)p+(x^2-y^2-zx)q=z(x-y).$	Analyze	CO 4	BAEB01.10
2	Solve the partial differential equation $(x^2-y^2-z^2)p+2xyq = 2xz$	Remember	CO 4	BAEB01.10
3	Solve $\frac{\partial^2 u}{\partial x\partial t}=e^{-t}\cos x$ given that u=0 when t = 0 and $\frac{\partial u}{\partial t}=0$ When x = 0 show also that as t tends to ∞ , u tends to sin x.	Understand	CO 4	BAEB01.11
4	Solve the partial differential equation $p\cos(x+y)+q\sin(x+y)=z$	Understand	CO 4	BAEB01.10
5	Solve the differential equation $(y+z)p+(z+x)q=x+y$	Understand	CO 4	BAEB01.10
6	Solve the one dimensional heat flow equation $\frac{\partial u}{\partial t}=c^2\frac{\partial^2 u}{\partial x^2}$ given that $u(0,t)=0, u(L,t)=0, t>0$ and $u(x,0)=3\sin((\pi x)/L), 0<x<L.$	Analyze	CO 4	BAEB01.11
7	Derive the complete solution for the one dimensional heat equation with zero boundary problem with initial temperature $u(x,0)=x(L-x)$ in the interval (0 , L).	Understand	CO 4	BAEB01.11
8	If a string of length l is initially at rest in equilibrium position and each of its points are given the velocity $V_0\sin^3\frac{\pi x}{l}$, find the displacement $y(x,t)$.	Analyze	CO 4	BAEB01.11
9	Solve the partial differential equation $\frac{x^2}{p}+\frac{y^2}{q}=z$	Understand	CO 4	BAEB01.10
10	A bar 100 cm long, with insulated sides, has its ends kept at 0^0C and 100^0C until steady state conditions prevail. The two ends are then suddenly insulated and kept so. Find the temperature distribution.	Remember	CO 4	BAEB01.11

UNIT -V				
MAJOR EQUATION TYPES ENCOUNTERED IN ENGINEERING AND PHYSICAL SCIENCES				
Part - A (Short Answer Questions)				
1	Write a short note on one dimensional wave equation.	Remember	CO 5	BCCB02.12
2	Explain method of separation of variables.	Remember	CO 5	BCCB02.15
3	Use D'Alembert principle of virtual work to verify that it gives the same equations of motion found by Newton.	Remember	CO 5	BCCB02.14
4	Explain about maximum principle.	Remember	CO 5	BCCB02.14
5	If the initial displacement is given to be zero then what is the initial velocity.	Remember	CO 5	BCCB02.12
6	If the string is released from rest and the initial non-zero displacement is given then what is the velocity.	Remember	CO 5	BCCB02.12
7	Examine the complex variable function f (z) = $\frac{x-iy}{x^2+y^2}$ for analyticity in Cartesian form.	Understand	CO 5	BCCB02.13
8	Calculate all the values of k such that f (z) = $e^x(cosky + isinky)$ is an analytic function.	Understand	CO 5	BCCB02.13
9	Obtain an analytic function f (z) whose imaginary part of the analytic function is v = $e^x(xsiny + ycosy)$.	Understand	CO 5	BCCB02.13
10	Show that the function f (z) = $\|z\|^2$ is continuous at all points of z but not differentiable at any $z \neq 0$.	Understand	CO 5	BCCB02.13
11	Define the term Analyticity of a complex variable function f (z).	Remember	CO 5	BCCB02.13
12	Define the term Continuity of a complex variable function f (z).	Remember	CO 5	BCCB02.13
13	Define the term Differentiability of a complex variable function f (z).	Remember	CO 5	BCCB02.13
14	If $w = f(z) = z^2 + z$. Find its real and imaginary parts.	Understand	CO 5	BCCB02.13
15	Examine the complex variable function f (z) = z^3 to analyticity for all values of z in Cartesian form.	Remember	CO 5	BCCB02.13
16	Verify whether the function $v = x^3y - xy^3 + xy + x + y$ can be imaginary part of an analytic function f (z) where z= x+ iy.	Understand	CO 5	BCCB02.13
17	Calculate the value of k such that f(x, y) = $x^3 + 3kxy^2$ may be harmonic function.	Remember	CO 5	BCCB02.14
18	Show that the real part of an analytic function f(z) where u = 2log ($x^2 + y^2$) is harmonic.	Understand	CO 5	BCCB02.14
19	Determine the conjugate harmonic function if the real part of an analytic function f (z) is u = $y^2 - 3x^2y$ is harmonic function.	Understand	CO 5	BCCB02.14
20	Verify whether u = $x^2 - y^2 - y$ of an analytic function can be harmonic function of an analytic function f (z) in the whole complex plane.	Understand	CO 5	BCCB02.14
Part - B (Long Answer Questions)				
1	A tightly stretched string with fixed end points x=0 and x= l is initially at rest its equilibrium position. If it is set to vibrate by giving each of its points a velocity $\lambda x(1-x)$, find the displacement of the string at any distance x from one end at any time t.	Understand	CO 5	BCCB02.12
2	Solve by the method of separation of variables $2xz_x - 3yz_y = 0$.	Understand	CO 5	BCCB02.15
3	Solve by the method of separation of variables $4u_x + u_y = 3u$ and $u(0,y) = e^{-5y}$	Understand	CO 5	BCCB02.15
4	A string is stretched and fastened to two points at x=0 and x=L. Motion is started by displacing the string into the form y=k(lx-x^2) from which it is released at time t=0. Find the displacement of any point on the string at a distance of x from one end at time t	Understand	CO 5	BCCB02.12
5	A tightly stretched string with fixed end points x=0 and x= l is initially in a position given by $y = y_0 \sin^3((\pi x)/l)$.If it is released from rest from this position, find the displacement(x,t).	Understand	CO 5	BCCB02.12
6	Obtain the general solution of the one dimensional wave equation	Understand	CO 5	BCCB02.12

	$\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$			
7	A tightly streched string with fixed end points $x = 0, x = l$ is initially in the position $y(x,0) = f(x)$. it is set vibrating by giving to each of its points a velocity $\frac{\partial y}{\partial t} = g(x)$ at $t = 0$. Find the displacement $y(x,t)$ in the form of Fourier series.	Understand	CO 5	BCCB02.12
8	Find the solution of the initial boundary value problem $\frac{\partial^2 y}{\partial t^2} = \frac{\partial^2 y}{\partial x^2}$, $0 \le x \le 1, t \ge 0$, subject to $y(x,0) = \sin \pi x, 0 \le x \le 1, y_t(x,0) = 0.$	Understand	CO 5	BCCB02.12
9	Solve the boundary value problem $u_{tt} = a^2 u_{xx}; 0 < x < l; t > 0$ with $u(0,t) = 0; u(l,t) = 0$ and $u(x,0) = 0, u_t(x,0) = \sin^3\left(\frac{\pi x}{l}\right)$	Understand	CO 5	BCCB02.12
10	The points of trisection of a tightly stretched string of length l with fixed ends are pulled aside through a distance d on opposite sides of the position of equilibrium and the string is released from rest. Obtain an expression for the displacement of the string at any subsequent time and show that the midpoint of the string is always at rest.	Understand	CO 5	BCCB02.12
11	Show that the real part of an analytic function f (z) where u = $e^{-2xy} \sin(x^2 - y^2)$ is a harmonic function. Hence find its harmonic conjugate.	Understand	CO 5	BCCB02.14
12	Prove that the real part of analytic function f (z) where u = $\log\|z\|^2$ is harmonic function. If so find the analytic function by Milne Thompson method.	Understand	CO 5	BCCB02.14
13	Show that real part u = $x^3 - 3xy^2$ of an analytic function f (z) is harmonic. Hence find the conjugate harmonic function and the analytic function.	Understand	CO 5	BCCB02.14
14	Show that the real part of an analytic function f (z) where u = $e^{-x}(xsiny - ycosy)$ is a harmonic function.	Understand	CO 5	BCCB02.14
15	If u and v are conjugate harmonic functions then show that uv is also a harmonic function.	Understand	CO 5	BCCB02.14
16	If f(z) = u + iv is an analytic function of z , then calculate f(z) if 2u + v = e^{2x} [(2x+y) cos2y + (x-2y) sin2y].	Understand	CO 5	BCCB02.13
17	Prove that $\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right) \|Realf(z)\|^2 = 2\|f'(z)\|^2$ where w = f (z) is an analytic function.	Understand	CO 5	BCCB02.13
18	Determine the imaginary part of an analytic function f (z) whose real part of an analytic function is $e^x(xcosy - ysiny)$.	Understand	CO 5	BCCB02.13
19	If $w = \emptyset + i\varphi$ represents the complex potential for an electric field where $\varphi = x^2 - y^2 + \frac{x}{x^2+y^2}$ then determine the function φ.	Understand	CO 5	BCCB02.13
20	Prove that the real and imaginary parts of an analytic function $f(z)$ are harmonic.	Understand	CO 5	BCCB02.12
	Part – C (Problem Solving and Critical Thinking)			
1	Solve $4u_x + u_y = 3u$ with $u(0,y) = 3e^{-y} - e^{-5y}$ by separation of variables.	Understand	CO 5	BCCB02.15
2	Solve $\frac{\partial^2 u}{\partial x \partial t} = e^{-t} \cos x$, given that $u = 0$ when $t = 0$ and $\frac{\partial u}{\partial t} = 0$ when $x = 0$. Show also that as t tends to ∞, u tends to $\sin x$	Understand	CO 5	BCCB02.12
3	Find the solution of the wave equation $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$ corresponding to the	Understand	CO 5	BCCB02.12

	triangular initial deflection $f(x)=\begin{cases}\frac{2k}{l}x, & where\ 0<x<\frac{l}{2}\\ \frac{2k}{l}(l-x), & where\ \frac{l}{2}<x<l\end{cases}$ and initial velocity equal to 0.			
4	Solve the boundary value problem $u_{tt}=a^2u_{xx};0<x<l;t>0$ with $u(0,t)=0;u(l,t)=0$ and $u(x,0)=0,u_t(x,0)=u_0x(l-x).$	Understand	CO 5	BCCB02.12
5	A tightly stretched string of length l has its ends fastened at $x=0,x=l.$ The midpoint of the string is then taken to height h and then released from rest in that position. Find the lateral displacement of a point of the string at time t from the instant of release.	Understand	CO 5	BCCB02.12
6	If u is a harmonic, show that $w=u^2$ is not a harmonic function unless u is a constant.	Understand	CO 5	BCCB02.14
7	If f(z) is an analytic function and u - v = $\frac{cosx+sinx-e^{-y}}{2cosx-e^{y}-e^{-y}}$ then determine the analytic function f(z) subjected to the condition f ($\frac{\pi}{2}$) = 0.	Understand	CO 5	BCCB02.13
8	Find an analytic function f(z) whose real part of it is u = $e^x[(x^2-y^2)cosy-2xy\ siny)]$.	Understand	CO 5	BCCB02.13
9	Find an analytic function f (z) such that $\text{Re}[f^{'}(z)]=3x^2-4y-3y^2$ and $f(1+i)=0$.	Understand	CO 5	BCCB02.13
10	Find an analytic function whose real part is $\frac{sin2x}{cosh2y-cos2x}$.	Understand	CO 5	BCCB02.13

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