



AIKTC/KRRC/SoET/ACKN/QUES/2018-19/

Date: _____

School: SoET-CBCS

Branch: MECH. ENGG.

SEM: IV

To,
 Exam Controller,
 AIKTC, New Panvel.

Dear Sir/Madam,

Received with thanks the following [✓]Semester/[✓]Unit Test-I/Unit Test-II (Reg./ATKT) question papers from your exam cell:

Sr. No.	Subject Name	Subject Code	Format		No. of Copies
			SC	HC	
1	Applied Mathematics- IV	MEC401		✓	02
2	Fluid Mechanics	MEC402		✓	02
3	Industrial Electronics	MEC403		✓	02
4	Production Process II	MEC404		✓	02
5	Kinematics of Machinery	MEC405		✓	02

Note: SC – Softcopy, HC - Hardcopy

(Shaheen Ansari)
 Librarian, AIKTC

Duration – 3 Hours Total Marks : 80

- N.B.:-** 1. Question no 1 is compulsory.
 2. Attempt any **THREE** questions out of remaining **FIVE** questions.

Q.1 a) Write the dual of the given LPP (5)
 Maximize $Z=4x_1 + 9x_2 + 2x_3$
 Subject to: $2x_1 + 3x_2 + 2x_3 \leq 7$, $3x_1 - 2x_2 + 4x_3 = 5$, $x_1, x_2, x_3 \geq 0$.

b) If X is a Random Variable with probability density function (5)

$$f(x) = \begin{cases} kx; 0 \leq x \leq 2 \\ 2k; 2 \leq x \leq 4 \\ 6k - kx; 4 \leq x \leq 6 \end{cases}$$

Find k, expectation and $P(1 \leq x \leq 3)$.

c) A tyre company claims that the life of the tyres have mean 42,000 kms with standard deviation of 4,000 kms. A change in the production process is believed to a result in better product. A test sample of 81 new tyres has a mean life 42,500 kms. Test at 5% level of significance that the new product is significantly better than the old one. (5)

d) Find the minimal polynomial of $A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$. Is A derogatory? (5)

Q.2 a) Use Big-M method to solve the following LPP (6)
 Minimize $Z = 2x_1 + x_2$
 subject to $3x_1 + x_2 = 3$,
 $4x_1 + 3x_2 \geq 6$,
 $x_1 + 2x_2 \leq 3$, $x_1, x_2 \geq 0$

b) Find c^* and d^* if $A = \begin{bmatrix} 3/2 & 1/2 \\ 1/2 & 3/2 \end{bmatrix}$ (6)

c) Verify Green's theorem for $\int_C (3x^2 - 8y^3) dx + (4y - 6xy^2) dy$ where C is the closed curve given by $y = x^2, y = \sqrt{x}$. (8)

Q.3 a) Prove that $\vec{F} = 2xz^2\hat{i} + (x^2z^2 + z \cos yz)\hat{j} + (2x^2yz + y \cos yz)\hat{k}$ is a conservative field. Find ϕ such that $\vec{F} = \nabla \phi$. Hence find the work done in moving an object in this field from $(0,0,1)$ to $(1, \frac{\pi}{4}, 2)$. (6)

b) The standard deviations calculated from two random samples of sizes 9 and 13 are 1.99 and 1.9. Can the samples be regard as drawn from the normal populations with same standard Deviations.
 (Given: $F(0.025) = 3.51$ with d. f. 8 & 12 and $F(0.025) = 4.20$ with d. f. 12 & 8.) (6)

- c) Find the index, rank, signature and class of the Quadratic Form $x_1^2 + 2x_2^2 + 3x_3^2 + 2x_1x_2 - 2x_1x_3 + 2x_2x_3$ by reducing it to canonical form using congruent transformation method. (8)

Q. 4 a) Evaluate $\iint_S \vec{F} \cdot d\vec{S}$ where $\vec{F} = (2xy + z)\hat{i} + y^2\hat{j} - (x + 3y)\hat{k}$ and S is the closed surface bounded by $x = 0, y = 0, z = 0, 2x + 2y + z = 6$. (6)

- b) Verify Cayley-Hamilton theorem for $A = \begin{bmatrix} 1 & 2 \\ 2 & 2 \end{bmatrix}$ and hence find (6)

$$2A^4 - 5A^3 - 7A + 6I.$$

- c) A sample of 400 students of under-graduate and 400 students of post-graduate classes was taken to know their opinion about autonomous colleges. 290 of the under-graduate and 310 of the post-graduate students favoured the autonomous status. Use chi-square test and test that the opinion regarding autonomous status of colleges is independent of the level of classes of students. (8)

Q. 5 a) Prove that $\nabla \times \left[\frac{\vec{a} \times \vec{r}}{r^3} \right] = \frac{-\vec{a}}{r^3} + \frac{3(\vec{a} \cdot \vec{r})\vec{r}}{r^5}$ (6)

- b) Show that the matrix $A = \begin{bmatrix} 3 & -1 & 1 \\ -1 & 3 & -1 \\ 1 & -1 & 3 \end{bmatrix}$ is diagonalizable and hence find the transforming matrix and diagonal matrix. (6)

- c) Ten school boys were given a test in statistics and their scores were recorded. They were given a month special coaching and a second test was given to them in the same subject at the end of the coaching period. Test at 5% level of significance, if the marks given below give evidence to the fact that the students are benefited by coaching. (8)

Mark in test 1: 70 68 56 75 80 90 68 75 56 58

Mark in test 2: 68 70 52 73 75 78 80 92 54 55

Q. 6 a) In a sample of 1000 cases, the mean of a certain test is 14 and Standard Deviation is 2.5. Assuming the distribution to be normal, find (6)

- 1] how many students score between 12 & 15.
- 2] how many score above 18.

- b) Evaluate by Stoke's theorem $\int_C xy \, dx + xy^2 \, dy$, where C is the square in the xy -plane with vertices $(1, 0), (0, 1), (-1, 0), (0, -1)$. (6)

c) Using duality solve the following L.P.P. (8)

$$\text{Minimise } z = 0.7x_1 + 0.5x_2$$

$$\text{subject to } x_1 \geq 4, x_2 \geq 6, x_1 + 2x_2 \geq 20, 2x_1 + x_2 \geq 18,$$

$$x_1, x_2, x_3 \geq 0.$$

[3 Hours]

[Marks: 80]

N.B Question no.1 is compulsory.
Attempt any **THREE** from question no.2 to 6.
Use illustrative diagrams wherever possible.

Q.1 Attempt any four from the following. Each question carry equal marks. 20

- a) Explain conditions of equilibrium of floating bodies
- b) Explain i) velocity potential function ii) stream function
- c) Do the following velocity component represent physically possible flow?

$$u = x^2y \quad ; \quad v = 2zy - xy^2 \quad ; \quad w = x^2 - z^2y$$

d) An aircraft is flying with a velocity of 200 m/s through the still air at -15°C . Find the stagnation pressure, if the mass density of the air is 1.08 kg/m^3 . Take pressure of the air as 80 kPa. Take $R = 287 \text{ J/kgK}$.

e) Explain surface tension and capillarity

Q.2 10

a) A heavy car plunges into a lake during an accident and lands at the bottom of the lake on its wheels. The door is 1.2 m high and 1 m wide, the top edge of the door is 8 m below the free surface of the water. Determine the hydrostatic force acting on the door approximating it as a vertical rectangular plate and the location of centre of pressure considering bottom of the lake surface as horizontal.

b) What is Venturimeter? Derive expression of the discharge through venturimeter. 10

Q.3 10

a) A 45° reducing bend is connected in a pipe line, the diameter at the inlet and outlet of the bend being 400 mm and 200 mm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet of bend is 215.8 kN/m^2 . The rate of flow of water is 500 lit/sec.

b) A fluid of viscosity 8 poise and specific gravity 1.2 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is 210 N/m^2 . Find i) The pressure gradient ii) The average velocity iii) Reynolds number of flow. 10

Q.4

10

- a) Two reservoirs with a difference in elevation of 15 m are connected by two pipes in series. The pipes are 150 m long of 20 cm diameter and 200 m long of 25 cm diameter respectively. The friction factors for the two pipes are respectively 0.020 and 0.019. Determine discharge through pipe considering both major and minor losses.

07

- b) What do you mean by boundary layer separation? What is the effect of pressure gradient on boundary layer separation?

- c) Define Mach number and give its significance.

03

Q.5

- a) Describe compressible flow through a convergent-divergent nozzle.

07

- b) What do you understand by displacement thickness and momentum thickness?

08

Determine displacement thickness and momentum thickness for the following velocity distribution:

$$\frac{u}{U_0} = \frac{3}{2} \left(\frac{y}{\delta} \right)$$

05

- c) A flow field is characterised by $\psi = x^2y$. Determine the velocity potential ϕ for the flow if the flow is irrotational.

Q.6

05

- a) An aeroplane is flying at a height of 20 km, where the temperature is -40°C . The speed of the plane is corresponding to $M = 1.8$. Assuming $k = 1.4$ and $R = 287 \text{ J/kgK}$. Find the speed of the plane.

- b) Explain streamlined body and bluff body.

05

- c) State and prove Bernoulli's theorem for streamline flow.

10

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17/5/19

Duration - Three Hrs.

Total Marks-80

- N. B. 1. Question No. 1 is compulsory
2. Solve any three questions out of remaining five questions.
3. Figures to the right indicate full marks

- Q.1 Attempt Any four of the followings
- A Draw and explain V-I characteristics of SCR 5
 - B Explain the need of freewheeling diode in controlled rectifier with R-L load. 5
 - C Draw and explain equivalent circuit of an OP-Amp. 5
 - D Differentiate Between Multiplexer and De-multiplexer. 5
 - E Compare between DC Motor and AC Motor. 5
- Q.2 A Draw and explain functional block diagram of timer IC 555. 7
B Draw and explain fan regulator circuit using TRIAC and DIAC. Draw Waveforms. 7
C State and prove Demorgan's theorems in Boolean Algebra. 6
- Q.3 A Draw and explain semi-controlled rectifier. Draw waveforms. 7
B Draw and explain MSP430 architecture. 7
C Draw and explain Instrumentation amplifier State its advantages and disadvantages. 6
- Q.4 A Draw and explain BLDC motor. State its advantages. 7
B State and Define specification parameters of Digital logic family. 7
C Explain construction and characteristics of Power BJT 6
- Q.5 A With the help of connection diagram, derive the relation for voltage gain in inverting mode of operation of operational amplifier. 7
B With the help of circuit diagram and waveforms, explain the generation of output voltage in three phase inverter in 180° conduction mode of operation. 7
C What do you understand by servo motor. State its applications. 6
- Q.6 A Draw and explain slip-torque characteristics of three phase AC motor. 7
B Draw and explain CMOS NAND gate with the help of truth table. 7
C Differentiate between microprocessor and Microcontroller. 6

(15)

23/5/19

(3 Hours)

[Total Marks : 80]

- N.B. (1) Question no. 1 is compulsory.
 (2) Attempt any three questions out of remaining five questions.
 (3) Illustrate your answer with necessary sketch wherever necessary.
 (4) Figures to the right indicate full marks.
 (5) Assume suitable data wherever necessary.

1. Attempt any FOUR of the following : (20)
 - (a) How does Additive Manufacturing differ from CNC machining?
 - (b) What is the difference between traditional and non-traditional machining processes?
 - (c) What is meant by grit, grade and structure of a grinding wheel?
 - (d) Differentiate between a compound die and combination die.
 - (e) What is meant by chip thickness ratio? What does it depend on? Draw a neat labelled sketch to show various angles and velocities related to chip thickness ratio.

2. (a) What are the factors determining the material removal rate in Electric Discharge Machining Process. Elaborate on them. (10)
 (b) Differentiate between Orthogonal and Oblique cutting. (10)

3. (a) Differentiate between blanking and punching process with a neat labelled sketch. (10)
 (b) What is meant by locating, Clamping and resting w.r.t. Jigs and Fixtures. (10)

4. (a) What is meant by a cutting tool signature? How do you express it in ORS and NRS system. Draw a neat labelled sketch to show it in the two systems along with the nomenclature, (10)
 (b) Describe the process of photo-polymerization with a neat labelled sketch. (10)

5. (a) What are the parameters governing Photo-polymerization process? (10)
 (b) What is meant by Tool Life Equation? How is it useful? (10)

6. Write short notes on: (20)
 - (a) Geometry of a broach.
 - (b) Laser Beam Machining
 - (c) Types of dynamometers used in machine tools.
 - (d) Use of locators in designing jigs and fixtures.
 - (e) Requirements of a Milling Fixture.

Time: 3 Hrs

[Total Marks 80]

N.B.:

- (1) Question No.1 is compulsory
- (2) Attempt any **three** questions out of remaining **five** questions.
- (3) Figures to right indicate full marks
- (4) Assume suitable data if **necessary**.
- (5) Notations carry usual meaning.

20

Q.1 Attempt any four

- A. State and prove Kennedy's Theorem
- B. Define i) Kinematic link ii) Kinematic pair iii) Kinematic chain.
- C. Classify follower in details.
- D. Explain self energizing and self locking brake.
- E. Explain the terms slip and creep in belts.
- F. State i) Work energy principle ii) D'Alembert's principle

- Q.2A. The mechanism, as shown in Fig. 1, the slider D is constrained to move on a horizontal path. The crank OA is rotating in the counter-clockwise direction at a speed of 180 r.p.m. The dimensions of various links are as follows : OA = 180 mm ; CB = 240 mm ; AB = 360 mm ; and BD = 540 mm. For the given configuration, find : 1. Velocity of slider D, 2. Angular velocity of links AB, CB and BD
1. By instantaneous centre method
 2. By relative velocity method

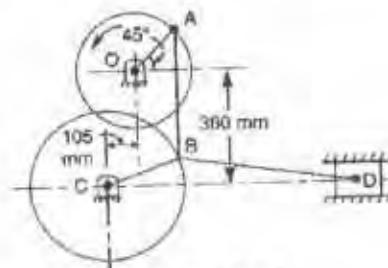


Figure No.1

- B. An open belt drive transmit power from a 300 mm diameter pulley running at 240 rpm to a pulley 450 mm diameter. Angle of lap on smaller pulley is 165° . The belt is on the point of slipping when 3KW is being transmitted. The coefficient of friction is 0.3. Determine effect on power transmission in following cases.
- i) Initial tension in the belt increased by 10%
 - ii) Suitable dressing is given to the belt surface to increase the coefficient of friction by 10%. Assume that initial tension is kept same.

- Q.3A Two 20° involute spur gear have a module of 10mm. The addendum is one module. The larger has 50 teeth and the pinion has 13 teeth. Does interference occur? If it occur, to what value the pressure angle be changed to eliminate interference. 10
- B. Differentiate between involute and cycloidal gear tooth profile. 04
- C. In a crank and slotted lever quick return mechanism the distance between the fixed centres is 350 mm and length of driving crank is 150 mm. Find the inclination of slotted lever with vertical in the extreme position and ratio of time of cutting stroke to return stroke. 06
- Q.4 A. A mechanism of a crank and slotted lever quick return motion is shown in Figure 2. If the crank rotates counter clockwise at 120 r.p.m., determine for the configuration shown, the velocity and acceleration of the ram D. Also determine the angular acceleration of the slotted lever. Crank, $AB = 150$ mm ; Slotted arm, $OC = 700$ mm and link $CD = 200$ mm. 14

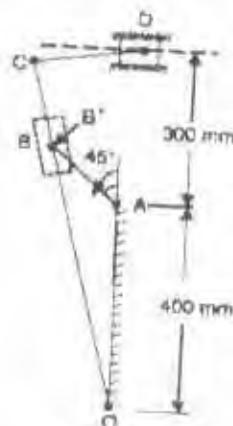


Figure No .2

- B. Draw a neat sketch of Tchebicheff mechanism & prove that the length of link must be in a ratio of 1:2:2:5. 06
- Q.5A. In an epicyclic gear train an annular wheel A having 54 teeth meshes with a planet wheel B which gears with a sun wheel C, the wheel A and C being co-axial. The wheel B is carried on a pin fixed on one end of arm P which rotates at 100 rpm about the axis of the wheel A and C. If the wheel A makes 20 rpm in clockwise direction and C has 24 teeth. Sketch the arrangement and determine rpm and sense of rotation of wheel C. 08
- B. A cord wrapped around a solid cylinder of radius 'r' and mass 'm'. The cylinder is released from rest. Determine the velocity of its centre of mass after it has moved down a distance 'h'. 06
- C. Two shafts are connected by Hooke's joint. The driving shafts rotates at a uniform speed of 1000 rpm. The angle between the shafts is 20° . Calculate the maximum and minimum speed of driven shafts, when acceleration of the driven shaft is maximum. 06

- Q.6A. The centre to centre distance between the two sprocket of a chain drive is 600mm. The chain drive is used to reduce speed from 180 rpm to 90 rpm on driving sprocket has 18 teeth and a pitch circle diameter of 480 mm determine i) Number of teeth on driven sprocket ii) Pitch and length of chain 08
- B. A cam is rotating at 200 rpm operate a reciprocating roller follower of radius 2.5 cm. The least radius of cam is 30mm . stroke of follower is 5cm. Ascent takes place by uniform acceleration and deceleration and descent by simple harmonic motion. Ascent take place by 70° and descent during 50° of cam rotation. Dwell between ascent and descent 60° . Sketch displacement, velocity, acceleration and jerk diagram. 12
