Annexure No. SA/14

School of Aeronautics(Neemrana)

I-04, RIICO Industrial Area, Neemrana, Dist. Alwar, Rajasthan

Fortnightly/Term : Mid Term -1 Date : 24. 02. 2018

Subject : Avionics - II (Th) Batch : AE - 5&6

Faculty Name : Mr. R. N. Jha & Kuldeep Singh Semester: VIII

(Answer any FIVE Questions. All Questions carry equal marks) **Total Marks: 45**

Q.No.	Questions	Unit Name / Topic
1.	Explain the operatopn of thermocouple type exhaust gas temprature indicating system. (9)	Unit No.: Topic Name: Source:
2.	Explain the operation of capacitance type fuel quantity indicating system. (9)	Unit No.: Topic Name: Source:
3.	Explain the construction and operation of altimeter. (9)	Unit No.: Topic Name: Source:
4.	Explain the construction and operation of air speed indicator and various type of error in it. (9)	Unit No. Topic Name: Source:

Q.No.	Questions	Unit Name / Topic
5.	Explain the construction and operation of vertical speed indicator . (9)	Unit No.: Topic Name: Source:
6.	Explain the operation of altitude alerting system and altitude reporting system. (9)	Unit No.: Topic Name: Source:
7.	Explain the bus bar sysytem with ac and non ac system. (9)	Unit No.: Topic Name: Source:
8.	Explain rectifier with their circuit diagram and applications. (9)	Unit No. Topic Name: Source:

School of Aeronautics (Neemrana)
I-04, RIICO Industrial Area, Neemrana, Dist. Alwar, Rajasthan

MODEL ANSWER PAPER

Name of Examination: Mid Term -1 Date of Examination: 24/2/2018

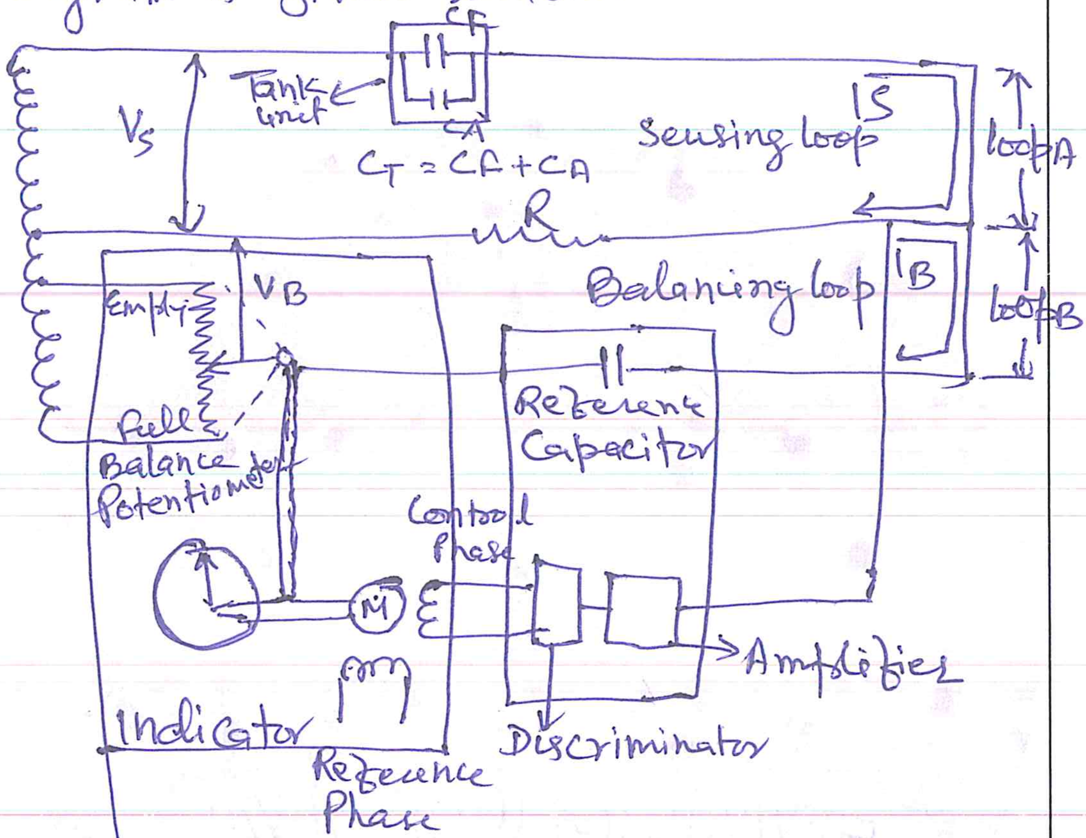
Subject SANJ AVIONICS -II Batch 5&6 Semester 8

Q. NO.	ANSWER	MARKS
1	Thermocouple type Exhaust gas temperature indicating system works on electrical energy which is produced by the direct conversion of heat energy at the measuring source. The Principle used is seebeck effect which states that when two dissimilar metals are joined at their ends so as to form two separate junctions and maintained at different temperature then a thermo-e.m.f is produced causing current to flow round the circuit. Thermo emf Produced is proportional to the difference of temperature at two junctions. The junction at higher temperature is known as hot junction and junction at lower temperature is known as cold junction. Thermocouple material is chosen according to temperature to be measured some commonly used metal combination in aircraft are Copper-Constantan — upto 400 °C Iron - Constantan — upto 850 °C Chromel - Alumel — upto 1100 °C Platinum - Rhodium — upto 1400 °C Different types of thermocouples are used for different types of engine.	

Q. NO.	ANSWER	MARKS
1	Surface contact type for Piston engine Immersion type for exhaust gas temperature Further it is modified as Rapid respon type for Turboprop Stagnation type for pure jet engine Nozzel guid vane type for measuring temperature between turbine stages. To utilize the thermoelectric principle for exhaust gas temperature measurement it is necessary to measure the emf generated at diffrent temperature. So a millivoltmeter calibrated in degree Celcius is connected in series with the circuit to form cold junction To get correct temperature of exhaust gas cold junction compensation has to be adopted. Bimetalic coil is used for this Purpose External circuit resistance has to be kept constant to avoid error due to temperature Variation and This is done with helps of connecting negative temperature Coefficient of resistance material spool in series with extension lead. e.g Eureka or Manganin.	

Q. NO.	ANSWER	MARKS
Q	Capacitance type fuel quantity indicating system Consists of a tank unit capacitor which is made up of Two Concentric tubes with narrow air gap between them length of the tube is equal to the depth of the fuel tank. capacitance of the tank unit varies as the level of the fuel which is acting as dielectric varies. Capacitance of the tank unit is given by $C_F = \frac{L}{H}(K-1)C_A$ where C_F = Capacitance due to fuel. C_A = Capacitance due to Air. L = is the level of fuel in the tank H = Height of the tank K = dielectric Constant of the fuel. A Reference Capacitor whose Capacitance is equal to the capacitance of tank unit when it is filled fuel. i.e. maximum capacitance of tank unit. Both the capacitors are connected to Power Source and arranged so as to form a bridge. Tank unit is given ~~Constant~~ Constant voltage Reference capacitor is given supply through the wiper of a potentiometer	

Q. NO.	ANSWER	MARKS
2	So that voltage is variable. circuit diagram is given below.	



An Amplifier is used to amplify the a servo operated indicator is used to indicate the fuel quantity.
When tank is full so the capacitance of tank unit and reference capacitor is equal wiper position at full so the sensing voltage and balancing voltage is also equal and so the sensing current and Balancing current is equal so no current flows through Resistor R. Pointer remains stationary at full position.

Q. NO.	ANSWER	MARKS
2	When fuel is drawn from the tank then tank unit capacitance decreases so does the sensing current decreases Bridge gets unbalanced and Balancing current Predominating through resistance R. A Signal voltage Proportional to IBR is developed across R. This acts as signal voltage and amplified and given to the Control winding of Seswo motor which drives the Pointer and Potentiometer wiper toward empty Position So that supply Voltage decreases to balance the current when fuel flow stops and Balancing current equals sensing current the bridge gets balanced and no current flows across Resistance R Motor Stop and indicator Pointer Shows new lower value. When fuel is added to the tank sensing current Predominates through Resistan R and the Phase of the Signal changes and Motor runs in opposite direction to indicate new higher value.	

Q. NO.	ANSWER	MARKS
3	Altimeter is used to indicated altitude of aircraft from sealevel or height of aircraft above the airfield by measuring the absolute static pressure of the atmosphere level at which the aircraft is flying at that instant. It consists of a stack of capsule which evacuated and sealed. This capsule expands as the static pressure in the case of altimeter decreases with increase in altitude. Expansion of the capsule is transfered to the pointer through link which is connected to capsule and Rocking shaft. Rocking shaft converts the linear motion of link into Rotary Motion and Rotates the sector gear. Sector gear meshes with Magnifying gear assembly which drives the handstaff carrying long pointer which	
	indicates hundreds of feet. A Pinion is mounted on the handstaff which drives the second gear Mechansim connected second Pointer which indicated 1000 feet. It is further connected to third Gear mechanism which drives the 10,000 Pointer. Hair spring controls the pointer movement.	

Q. NO.	ANSWER	MARKS
3	There is a Pressure setting and Millibar counter for setting QNH QFE or QNE as per Pilots requirement during takeoff and landing and flying above transition altitude. In order to compensate for non-linear Pressure/altitude relationship and to obtain scale linearity suitable mechanism is incorporated by mean variable magnification lever and gear system. use of cam and cam follower mechanism. suitable material has to be chosen for capsule to suit the deflection curve. Temperature compensation is achieved by a U bracket made of bimetal which controls the pressure on the capsule with change in altitude and temperature. Trace disc or low level warning flag is used to avoid confusion below 10000 feet level and above 10000 feet flight level in the pointer and dial presentation.	

School of Aeronautics (Neemrana)

I-04, RIICO Industrial Area, Neemrana, Dist. Alwar, Rajasthan

Q. NO.	ANSWER	MARKS
4	Airspeed indicator is used indicated speed of aircraft by measuring the differential pressure between Pitot pressure and Static pressure sensed by the Pitot head or Static vents. This is achived by giving Pitot Pressure inside capsule and Static Pressure in the case of the instrument. When aircraft is moving forward the Pitot Pressure is greater than Static Pressure so the capsule expands and its expsion is proportional to dynamic Pressure given by formula $P = \frac{1}{2} \rho V^2$ where P is the differential Pr. ρ is the density of air V is the velocity of A/c. Expanision of capsule is transfered to the indicating mechanism & pointer via Link, Rocking shaft, Sector gear, Pinion. Pointer movement is controlled by Hair Spring. The indicated airspeed is not the true air speed because of different error. Airspeed compensated for instrument error is called indicated airspeed. indicated airspeed when compensated for Pressure error is called computed air speed. computed airspeed when compensated for square law it is called calibrated airspeed. Calibrated airspeed when compensated for compressibility error called equivalent airspeed. equivalent air speed compensated for Density and Temperature called True air speed.	

Q. NO.	ANSWER	MARKS
5	Vertical Speed indicator used to indicate the rate ascent or rate of descent of aircraft in feet/minute. This works on the principle of measuring differential Static Pressure which is created by metering unit or calibrated leak assembly. Instantaneous static Pressure is fed inside the capsule and the output of Metering unit is given in the case. Metering unit creates a lag of maximum 4 seconds. Metering unit consist of a capillary and orifice. It can be a ceramic leak assembly with mechanical temperature/viscosity compensator. VSI has two scale one for rate of ascent and other for rate of descent. zero is at 9 o'clock Position to give a natural feeling of ascent with Pointer moving up and natural feeling of descent with Pointer going down zero. When aircraft starts climbing up static Pressure inside starts decreasing but in case pressure change is delayed so capsule is compressed and this compression of capsule is transferred to Pointer through link, Rocking shaft and sector Gear, Pinion to indicate rate of climb and vice-versa during descent.	

School of Aeronautics (Neemrana)

I-04, RIICO Industrial Area, Neemrana, Dist. Alwar, Rajasthan

Q. NO.	ANSWER	MARKS
6	Altitude Alerting unit is designed to give Audio and visual signal warning when an aircraft approaches or deviates from preselected altitude by more than predetermined amount. It consists of a servo altimeter and altitude controller. Altitude is selected on the controller and converted in electrical signal by synchro. Altimeter gives the present altitude signal through the synchro. These two signal are given to logic circuit with timming network and controls the Audio warning device and warning light in servo altimeter. Sequence of alerting during approach at preset outer limit of 900 feet Audio warning comes for two second and warning light remain until it comes within 300 feet of preset. Alerting during deviation. If it departs the preset altitude by 300 feet Audio warning for two seconds and visual warning remain until a/c returns within 300 feet or it cross 900 feet. Altitude reporting unit uses encoding altimeter and Transponder. When it recieves interogating signal at 1030 MHz then transmitts the encoded value of altitude at 1090 MHz. ATC uses ATC secondary surveillence radar for introgation.	

Note

1. Paper Setter is required to carefully write the answers for the questions, after consulting all the relevant books.
2. For any discripencies found in answers, paper setter will be held responsible for playing with the career of the students,and doing breach of trust with them, and accordingly action can be taken by the disiplinary committee in this regard.
3. Principal before signing for the correctness of the answer shall ensure the same from relevant books. Point No. 1 & 2 above are applicable to Principal also in case any discripencies are found in answers

Dated 25/2/2018 Signature of Paper Setter Signature of Principal/HOD

School of Aeronautics (Neemrana)
I-04, RIICO Industrial Area, Neemrana, Dist. Alwar, Rajasthan

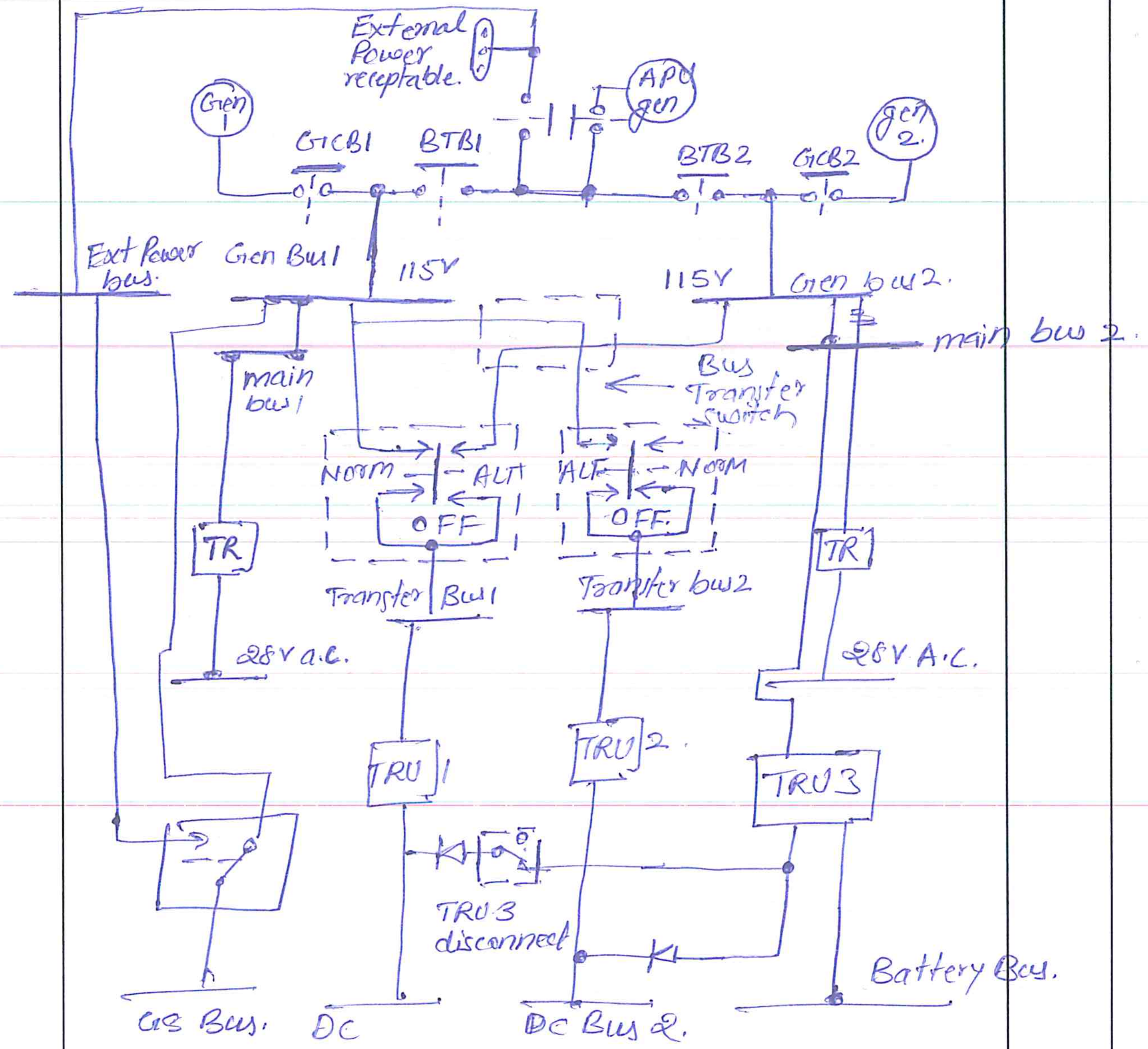
MODEL ANSWER PAPER

Name of Examination: MIDTERM-I Date of Examination: 24/2/18.

Subject AVIONICS - II. Batch 586. Semester 8th

Q. NO.	ANSWER	MARKS
7.	Bus Bar System ▶ In all Type of aircraft output from generating source is coupled to one or more Low Impedence conductors. reffered to as bus bars. Junction Box or distribution panels located at central points within aircraft. They provide positive supply to various consumers circuits. They also perform "carry-all" function. In Paralleling generators provide adequate circuit protection. devices & by isolating the faulted generators. All consumer services they fall into three groups. (I). Vital (II). Essential (III). Non-essential. Vital Services which would be Required after an emergency wheels-up landing i.e. emergency lighting and crash switch operation. They are connected directly to Battery. Essential Services - To ensure safe flight in flight emergency situation and connected to d.c & a.c bus bars, always be supplied from a generator or from batteries. Non-Essential Services which can be isolated in an in flight Emergency for Load shedding purpose and are connected to dc & AC bus bars, supplied from a generator.	

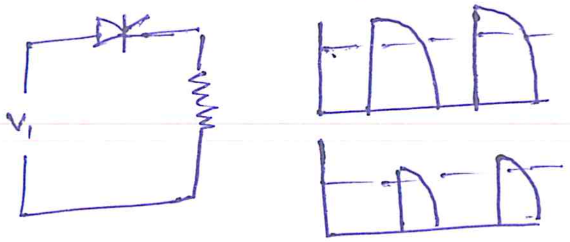
Q. NO.	ANSWER	MARKS



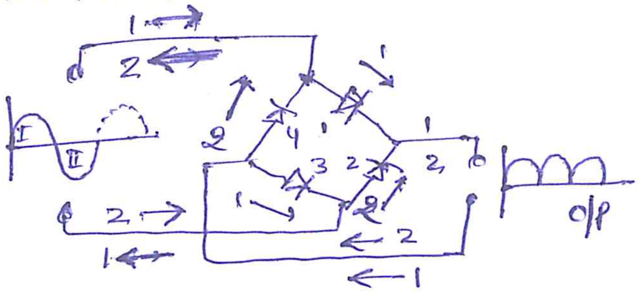
Main a.c and d.c Power distribution system N.N. (Parallel).

Q. NO.	ANSWER	MARKS
Q8	Explain Rectifier with their circuit diagram & Applications.	
Sol.	Rectification means process of converting an a.c supply into a d.c supply with the help of static apparatus is known as Rectifier.	

Variable d.c output from a Silicon Controlled Rectifier



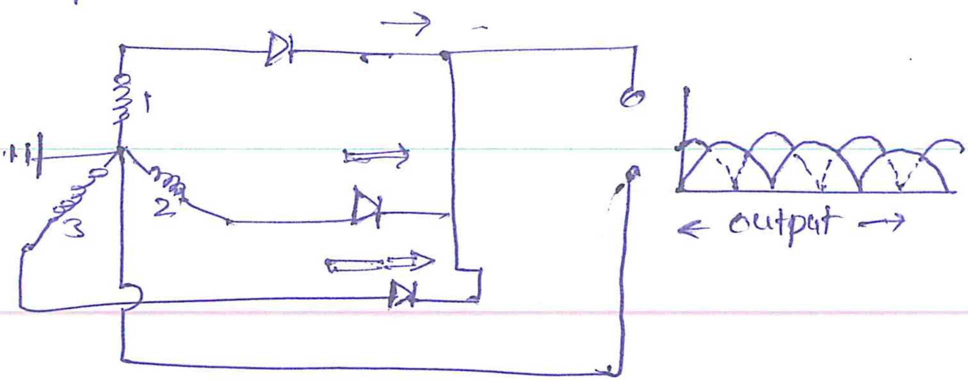
RECTIFIER CONNECTIONS:-



Full wave (Single phase) Rectification.

Q. NO.	ANSWER	MARKS

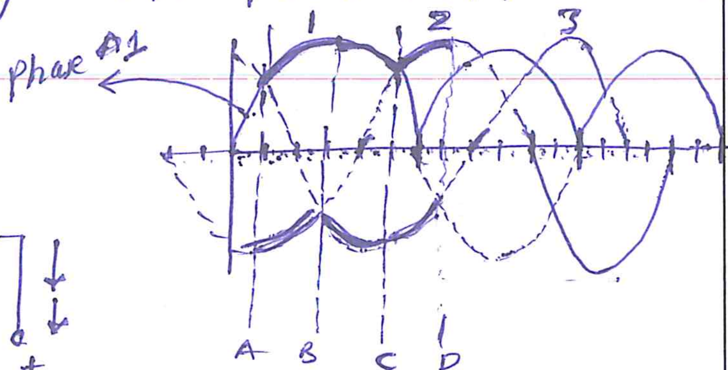
Three phase half wave Rectification.

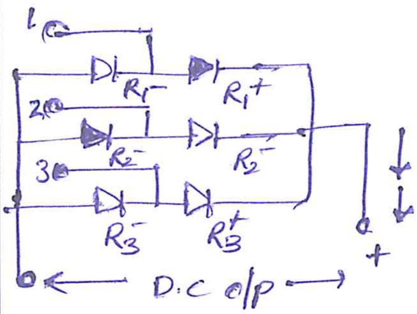


Current flow phas - 1. →
" " " 2 ⇒
" " " 3 ⇛

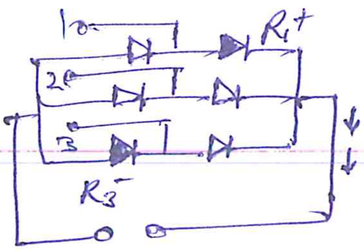
Full wave Rectification of a 3-ϕ a.c input:-

Most commonly used for power Rectification in aircraft.

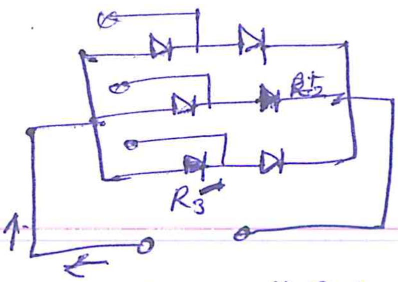




Line volt between Phase 1 & 2



(line volt 1, 3)



line volt Between 2 & 3

Q. NO.	ANSWER	MARKS
	R_1^- & R_2^+ conduct when volt applied between 1 & 2 Phase. R_1^- & R_3^+ Conduct when volt applied between 1 & 3. R_3^+ & R_2^- conduct when volt applied between 2 & 3. only two diode will conduct at a time. one Rectifier for -ve cycle 2nd Rectifier for +ve cycle. As shown in waveform of 3-phase At point A to B R_1^+ & R_2^- B to C R_1^+ & R_3^- C to D R_2^+ & R_3^-	

Note

1. Paper Setter is required to carefully write the answers for the questions, after consulting all the relevant books.
2. For any discripencies found in answers, paper setter will be held responsible for playing with the career of the students,and doing breach of trust with them, and accordingly action can be taken by the disiplinary committee in this regard.
3. Principal before signing for the correctness of the answer shall ensure the same from relevant books. Point No. 1 & 2 above are applicable to Principal also in case any discripencies are found in answers

Dated 28.2.2018 Signature of Paper Setter Signature of Principal/HOD

Annexure No. SA/14

School of Aeronautics(Neemrana)

I-04, RIICO Industrial Area, Neemrana, Dist. Alwar, Rajasthan

Fortnightly/Term : Mid Term -1 Date : 24. 02. 2018

Subject : CAD (Th) Batch : AE - 5&6

Faculty Name : Mr. Anubhav Goel Semester: VIII

(Answer any FIVE Questions. All Questions carry equal marks) **Total Marks: 45**

Q.No.	Questions	Unit Name / Topic
1.	What do you understand by curves? What are the different types of curves and explain the method of curve representation as discussed. (3+3+3)	Unit No.: Topic Name: Source:
2.	A Hermite Cubic Spline curve is represented by the coordinates A(3,5) and B(8,10). The tangent vectors at these points are given by (0,4) and (4,0). Find the coordinates of the curve at u=0.5, 0.6 and 0.7 . (9)	Unit No.: Topic Name: Source:
3.	What are the different types of synthetic curves? Explain with equation & deduce the equation for the Hermite Cubic Spline curve in analytic as well the matrix form? (9)	Unit No.: Topic Name: Source:
4.	Explain the concept of Curvature continuity to understand the types of curves? (9)	Unit No. Topic Name: Source:

Q.No.	Questions	Unit Name / Topic
5.	Fit a Bezier curve for the following control points: (1,3), (4,5), (5,7), (8,4). Calculate the points at u=0.4 and 0.6 (9)	Unit No.: Topic Name: Source:
6.	Find the equation of a Bezier curve defined by the control points : (30,30), (50,80), (100,100), (150,30). (9)	Unit No.: Topic Name: Source:
7.	What is the parametric representation of curves? Deduce the generalized equation for a line and a circle using a local parameter as "u". (9)	Unit No.: Topic Name: Source:
8.	A square with an edge length of 10 units is located in the origin with one of the edges at an angle of 30 θ with the X-axis. Calculate the new position of the square if it is rotated about the Z-axis by an angle of 30 θ in the clockwise direction. (9)	Unit No. Topic Name: Source:

School of Aeronautics (Neemrana)
I-04, RIICO Industrial Area, Neemrana, Dist. Alwar, Rajasthan

MODEL ANSWER PAPER

Name of Examination: Mid Term Date of Examination:

Subject CAD Unit - 2 Curves Batch 5&6 Semester 8th.

Q. NO.	ANSWER	MARKS
Ques 1	Curve design Concepts →	
	A curve can be defined as a line or outline which deviates gradually from being straight for some or all of its length. A curve can be described by arrays of coordinate data or by an analytic equation.	
	→ Coordinate array method is cumbersome as the exact shape of the curve is not known so there are are lot of computations required.	
	→ Analytic array method is easy from the design point of view because it provides information such as curve behavior, control, continuity and curvature.	
	Curves can be described mathematically by nonparametric or parametric equations. Nonparametric equations can be explicit or implicit.	
	For a nonparametric curve, the coordinates y and z of a point on the curve are expressed as two separate functions of the third coordinate x as the independent variable.	

Q. NO.	ANSWER	MARKS

This curve representation is known as the nonparametric explicit form. If the coordinates x, y and z are related together by two functions, a nonparametric implicit form results.

For a parametric curve, on the other hand, a parameter is introduced and the coordinates x, y and z are expressed as functions of this parameter.

Explicit nonparametric representation of a 3-D curve →

(fig (2.1)) $P = [x \; y \; z]^T = [x \; f(x) \; g(x)]^T$

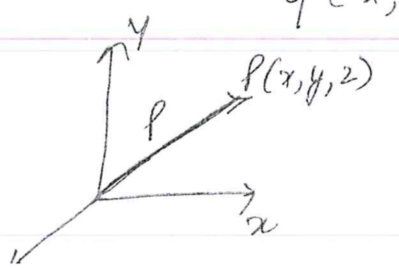
where P is positive vector of point P.

This is a one-to one relationship curve.

So this form cannot be used to represent closed or multivalued curves.

The implicit nonparametric representation solves this problem and is given by intersection of two surfaces

$$F(x, y, z) = 0$$
$$G(x, y, z) = 0$$



Q. NO.	ANSWER	MARKS

Parametric representation of curves ~~curves~~ allows closed and multiple-valued functions to be easily defined and replaces the use of slopes with that of tangent vectors.

parametric form, each point on a curve is expressed as a function of a parameter u. The parameter acts as a local coordinate for points on the curve. The parametric equation for a 3-D curve in space takes the following vector form :-

$$P(u) = [x \; y \; z]^T = [x(u) \; y(u) \; z(u)]^T$$

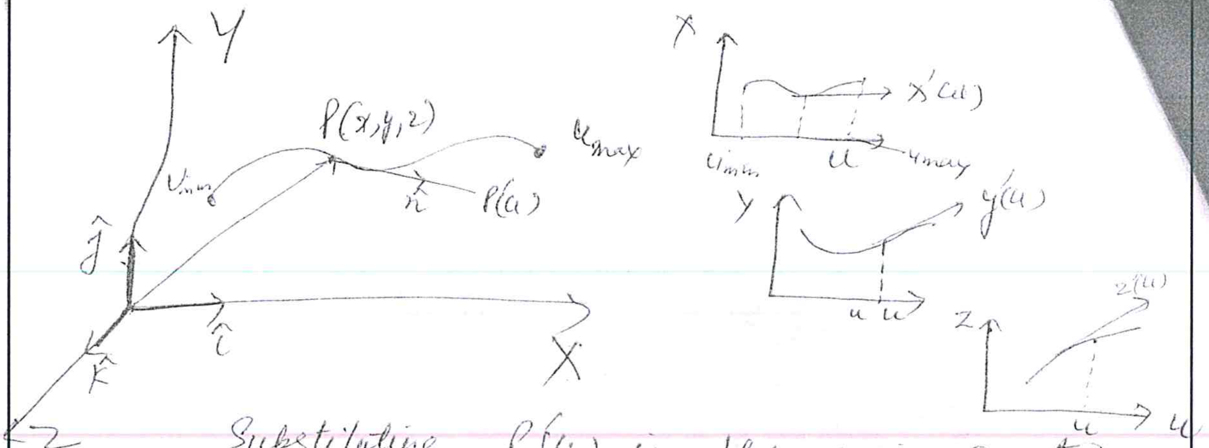
$$u_{min} \leq u \leq u_{max}$$

This equation can be used to check whether a given point lies on the curve or not. Reduces ~~the~~ to finding if the corresponding value lies in the given range of u or not.

To evaluate slope of a parametric curve at an arbitrary point, calculate the tangent vector defined by vector P(u) in the cartesian space.

$$P'(u) = \frac{dP(u)}{du}$$

Q. NO.	ANSWER	MARKS



Substituting P(u) in the main equation yields the component of the tangent vector in the parametric space.

$$P'(u) = [x' \; y' \; z']^T$$

$$= [x'(u) \; y'(u) \; z'(u)]^T, \quad u_{min} \le u \le u_{max}.$$

Where $x'(u)$, $y'(u)$ and $z'(u)$ are the first parametric derivatives of the position vector components $x(u)$, $y(u)$, $z(u)$ resp. The slope of the curve are given by the ratios of the components of the tangent vector:

$$\frac{dy}{dx} = \frac{dy/du}{dx/du} = \frac{y'}{x'}$$

$$\frac{dz}{dy} = \frac{z'}{y'} \quad \text{and} \quad \frac{dx}{dz} = \frac{x'}{z'}$$

The tangent vector has the same direction as the tangent to the curve. The magnitude is →

$$|P'(u)| = \sqrt{x'^2 + y'^2 + z'^2}$$

and direction = $\hat{n} = \dfrac{P(u)}{|P'(u)|} = n_x\hat{i} + n_y\hat{j} + n_z\hat{k}$.

Q. NO.	ANSWER	MARKS
Q3a	The generalised equation of a Hermite Cubic Spline curve is →	

$$\begin{bmatrix}1 & u & u^2 & u^3\end{bmatrix}\begin{bmatrix}1 & 0 & 0 & 0\\ 0 & 0 & 1 & 0\\ -3 & 3 & -2 & -1\\ 2 & -2 & 1 & 1\end{bmatrix}\begin{bmatrix}x\\ x_1\\ x_0'\\ x_1'\end{bmatrix}$$

Points are [3, 5] [8, 10] [0, 4] [4, 0]

at $u = 0.5$

$$\begin{bmatrix}1 & .5 & .25 & .125\end{bmatrix}\begin{bmatrix}1 & 0 & 0 & 0\\ 0 & 0 & 1 & 0\\ -3 & 3 & -2 & -1\\ 2 & -2 & 1 & 1\end{bmatrix}\begin{bmatrix}\text{Points put accordingly}\end{bmatrix}$$

u at 0.5 = [5, 8]

u at 0.6 = $[x_1, y_1]$

u at 0.7 = $[x_2, y_2]$

Ans

Q. NO.	ANSWER	MARKS
	and the recursive relationships reduces to	
	$x_{n+1} = x_n \cos\alpha + (1-\cos\alpha)x_v + (\Delta u \cos\alpha - \sin\alpha)(y_n - y_v) + A\Delta u(\Delta u \cos\alpha - 2\sin\alpha)$	
	$y_{n+1} = (\cos\alpha + \Delta u \sin\alpha)y_n + (1-\cos\alpha - \Delta u \sin\alpha)y_v + (x_n - x_v)\sin\alpha + A\Delta u(\Delta u \sin\alpha + 2\cos\alpha)$	
	$z_{n+1} = z_n$.	
Ques3	**Parametric representation of synthetic Curves :-**	
	* Analytic curves, described previously, are usually not sufficient to meet geometric design requirements of mechanical parts.	
	* Products such as car bodies, ship hulls, airplane fuselage and wings, propeller blades, shoe insoles and bottles are a few examples of synthetic curves.	
	Need for synthetic curves →	
	* When a curve is represented by a collection of measured data points.	
	* when an existing curve must change to meet new design requirements.	
	The synthetic curves are represented in the order of continuity form when a complex curve is modeled by several curve segments pieced	

Q. NO.	ANSWER	MARKS
	together end to end. → Zero-order continuity (C^0) yields a position continuous curve. → First (C^1) and second (C^2)-order continuous imply slope and curvature continuous curve resp. → A C^1 curve is minimum acceptable for engg. drawings. → A cubic polynomial is the minimum that can guarentee the generation of curves. Major CAD/CAM systems provide three types of synthetic curves → (a) Hermite cubic splines (first order) (b) Bezier curves (first order) (c) B-spline curves. (second order Hermite Cubic Splines :— The parametric cubic spline curve connects two data points and utilizes a cubic equation. Therefore, four conditions are required to determine the coefficients of the equation. The Hermite cubic spline is resulted by position of the two endpoints and the two tangent vectors at that points.	

Q. NO.	ANSWER	MARKS

Parametric equation is given by:-

$$P(u) = \sum_{i=0}^{3} C_i u^i , \quad 0 \le u \le 1 \quad \text{— (1)}$$

where u is the parameter and C_i are the polynomials

In scaler form →

$$x(u) = C_{3x}u^3 + C_{2x}u^2 + C_{1x}u + C_{0x}$$
$$y(u) = C_{3y}u^3 + C_{2y}u^2 + C_{1y}u + C_{0y}$$
$$z(u) = C_{3z}u^3 + C_{3z}u^2 + C_{1z}u + C_{0z}$$

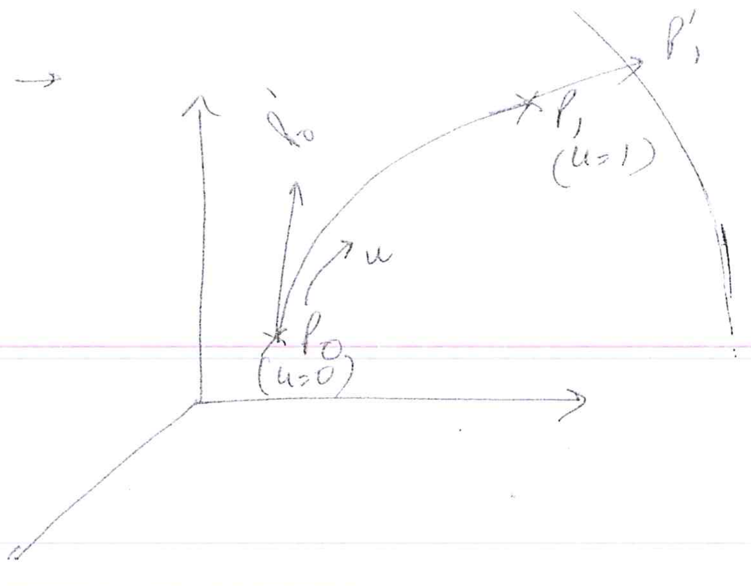
Vector form →

$$P(u) = C_3u^3 + C_2u^2 + C_1u + C_0 \quad \text{— (2)}$$

The tangent vector to the curve at any given point is given by differeneration of eq. (1)

$$P'(u) = \sum_{i=0}^{3} C_i\, i\, u^{i-1} , \quad 0 \le u \le 1 \quad \text{— (3)}$$

For example →



Q. NO.	ANSWER	MARKS
	Applying the boundry conditions → (P_0, P_0' at $u=0$ and P_1, P_1' at $u=1$) we got results →	

$$P_0 = C_0$$
$$P_0' = C_1$$
$$P_1 = C_3 + C_2 + C_1 + C_0$$
$$P_1' = 3C_3 + 2C_2 + C_1$$

Solving these equations simultaneously for all the coffients →

$$C_0 = P_0$$
$$C_1 = P_0'$$
$$C_2 = 3(P_1 - P_0) - 2(P_0' - P_1')$$
$$C_3 = 2(P_0 - P_1) + P_0' + P_1'$$

Substituting these values in equation (2) and Rearranging →

$$P(u) = (2u^3 - 3u^2 + 1)P_0 + (-2u^3 + 3u^2)P_1 + (u^3 - 2u^2 + u)P_0' + (u^3 - u^2)P_1' \quad \boxed{0 \le u \le 1}$$

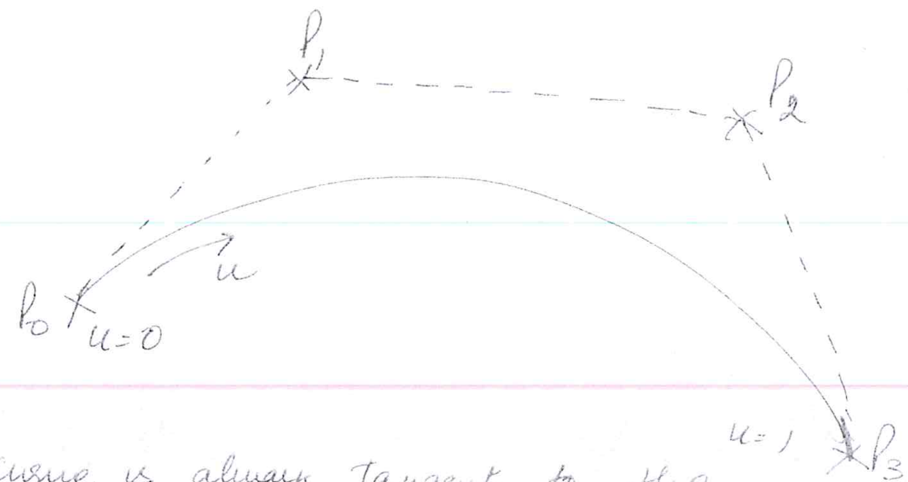
P_0, P_1, P_0', P_1' are called geometric coefficients.

The tangent vector becomes →

$$P'(u) = (6u^2 - 6u)P_0 + (-6u^2 + 6u)P_1 + (3u^2 - 4u + 1)P_0' + (3u^2 - 2u)P_1' \quad \boxed{0 \le u \le 1}$$

Q. NO.	ANSWER	MARKS
	16	
	1. Bezier Curves → Bezier curves are the curves that are formed by the approximation technique rather that the interpolation technique used in cubic spline curves. ese curves do not pass through the given data points ut instead these points are used to control the shape of the resulting curve. Approximation technique is ~~pactg~~ preferred over the nterpolation technique because it gives more flexibility and adds intuitive feel. These curves and surfaces were ~~formed~~ ~~d~~ formed by P. Bezier of the French car firm Régie Renault to create ~~ca~~ definitions for outer panal of cars. Major differences b/w cubic spline & Bezier curves:- (1) Shape of Bezier curves is controlled by defining points only. First derivatives are not used as in case of cubic spline curves. (2) Order of the degree of Bezier curve is variable. order and degree of cubic spline curve is always three. (3) Bezier curve is smoother than cubic spline.	

Q. NO.	ANSWER	MARKS



The curve is always tangent to the first and last polygon segment.

Mathematically for $n+1$ points, Bezier curve is defined as :-

$$P(u) = \sum_{i=0}^{n} P_i B_{i,n}(u), \quad 0 \le u \le 1$$

where $P(u)$ is any point on the curve and P_i is a control point

$B_{i,n}$ are the Bernstein polynomials.

Bernstein polynomial $= B_{i,n}(u) = C(n,i)\, u^i (1-u)^{n-i}$

where $C(n,i) = \dfrac{n!}{i!\,(n-i)!}$

Using this the ~~Bernstein~~ Bezier curve equation can be written as :-

$$P(u) = P_0 (1-u)^n + P_1 C(n,1)\, u (1-u)^{n-1} + P_2 C(n,2)\, u^2 (1-u)^{n-2} + \ldots P_{n-1} C(n,n-1)\, u^{n-1}(1-u) + P_n u^n$$

$0 \le u \le 1$

Q. NO.	ANSWER	MARKS

Characteristics of the Bezier curves are based on the properties of the Bernstein polynomials

→ Curve interpolates the first and last control points, i.e it passes through P_0 and P_n if we substitute $u = 0$ and 1.

→ The curve is tangent to the first and last segments of the characteristic polynomials

$$P^r(0) = \frac{n!}{(n-r)!} \sum_{i=0}^{r} (-1)^{r-i} C(r,i) P_i$$

$$P^r(1) = \frac{n!}{(n-r)!} \sum_{i=0}^{r} (-1)^{i} C(r,i) P_{n-i}$$

→ The curve is symmetric with respect to u and $(1-u)$.

→ The curve shape can be modified by either changing one or more vertices of its polygon or by keeping the polygon fixed and specifying multiple coincident points at a vertex.

→ A closed Bezier curve can simply be generated by closing its characteristics polygon or by choosing P_0 and P_n to be coincident.

→ For any valid value of u, the sum of the $B_{i,n}$ [illegible] points is always

Q. NO.	ANSWER	MARKS
	B-spline Curves → → B-spline curves provide effective method of generating curves defined by polynomials. → B-spline curve provide local control of the curve shape as opposed to global control by using a special set of blending functions that provide local influence. → They also provide the ability to add control points without increasing the degree of the curve. → B-spline curves have the ability to interpolate and or approximate a set of given data points. → The theory of B-spline curves separates the degree of the resulting curve from the no. of the given control points. → While four control points can always produce a cubic Bezier curve, they can generate a linear, quadratic or cubic B-spline curve. This flexibility in the degree of resulting curve is achieved by choosing the basis functions of B-spline curves with an additional degree of freedom that does not exist in Bernstein Polynomials.	

Q. NO.	ANSWER	MARKS

18

The B-spline curves defined by n+1 control points P_i, is given by →

$$P(u) = \sum_{i=0}^{n} P_i N_{i,k}(u) \quad 0 \le u \le u_{max}$$

$N_{i,k}(u)$ are the B-spline functions.

There are two major differences between the general equations of B-spline and Bezier curves;—

1. The parameter controls the degree (k-1) of the resulting curve.
2. The maximum limit of the parameter u is no longer unity.

The B-spline curves have the following property:—

Partition of unity :— $\sum_{i=0}^{n} N_{i,k}(u) = 1$

Positivity : $N_{i,k}(u) \geq 0$

Local support : $N_{i,k}(u) = 0$ if $u \notin [u_i, u_{i+k+1}]$

Continuity : $N_{i,k}(u)$ is (k-2) times continuously differentiable.

→ The first property indicates/ensures that the relationship between the curve and its defining control points is invariant under affine transformations.

Q. NO.	ANSWER	MARKS

Ques 4

Example 4.8 Fit a cubic Bézier curve for the following control points: (1, 3), (4, 5), (5, 7) and (8,
Calculate the points at $u = 0.4$ and 0.6.

Solution The equation of the curve is given by

$$p(u) = [u^3 \quad u^2 \quad u \quad 1] \begin{bmatrix} -1 & 3 & -3 & 1 \\ 3 & -6 & 3 & 0 \\ -3 & 3 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 1 & 3 \\ 4 & 5 \\ 5 & 7 \\ 8 & 4 \end{bmatrix}$$

$$= [u^3 \quad u^2 \quad u \quad 1] \begin{bmatrix} 4 & -5 \\ -6 & 0 \\ 9 & 6 \\ 1 & 3 \end{bmatrix}$$

$$= [(4u^3 - 6u^2 + 9u + 1), (-5u^3 + 6u + 3)]$$

For $u = 0.4$

$$\mathbf{p}(0.4) = [4(0.4)^3 - 6\,(0.4)^2 + 9\,(0.4) + 1, -5\,(0.4)^3 + 6\,(0.4) + 3] = [3.896, 5.08]$$

For $u = 0.6$

$$\mathbf{p}(0.6) = [4(0.6)^3 - 6(0.6)^2 + 9(0.6) + 1, -5(0.6)^3 + 6(0.6) + 3] = [5.104, 4.08]$$

5

B-splines One of the problems associated with the Bézier curves is with an increase in the number of con
points, the order of the polynomial representing the curve increases. To reduce this complexity, the curv

Q. NO.	ANSWER	MARKS

Ques 5

oordinate frame ...

le 4.7 A cubic Bézier curve is defined by the control points as (20, 20), (60, 80), (120, 100), and (150, 30). Find the equation of the curve and its midpoint.

The equation of the curve is given by

$$p(u) = [u^3 \quad u^2 \quad u \quad 1]\begin{bmatrix} -1 & 3 & -3 & 1 \\ 3 & -6 & 3 & 0 \\ -3 & 3 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}_{4\times4}\begin{bmatrix} 20 & 20 \\ 60 & 80 \\ 120 & 100 \\ 150 & 30 \end{bmatrix}_{4\times2}$$

$$= [u^3 \quad u^2 \quad u \quad 1]_{1\times4}\begin{bmatrix} -50 & -50 \\ 60 & -120 \\ 120 & 180 \\ 20 & 20 \end{bmatrix}_{4\times2}$$

$$= [(-50\,u^3 + 60\,u^2 + 120\,u + 20),\ (-50\,u^3 - 120\,u^2 + 180\,u + 20)]_{1\times2}$$

possible to calculate the x and y coordinates of the Bézier curve by varying the parameter u from n the above equations on the right-hand side.

oint is when $u = 0.5$

$$p(0.5) = [-50\,(0.5)^3 + 60\,(0.5)^2 + 120\,(0.5) + 20,\ -50\,(0.5)^3 - 120\,(0.5)^2 + 180\,(0.5) + 20] = [88.75, 73.75]$$

Q. NO.	ANSWER	MARKS

Ques 6

6.5 CURVATURE CONTINUITY

Two boundary curve segments shown in Figure 6.12 are meeting at a vertex X. Let these two curves be described as $f(u)$ and $g(v)$, where u and v are values in intervals $[a, b]$ and $[m, n]$, respectively. The problem is: how we can make sure that these curves join together in a 'smooth' way?

Consider the 'endpoint' of curve $f(b)$ and the 'start point' of curve $g(m)$. If $f(b)$ and $g(m)$ are equal as shown in Figure 6.12a, we shall say curves f() and g() are C^0 continuous at $f(b) = g(m)$.

If for all $i <= k$, the i-th derivatives at $f(b)$ and $g(m)$ are equal, we shall say that the curves are C^k continuous at point $f(b) = g(m)$. Intuitively, two curves are C^0 continuous at the joining point if we can go from one curve to the other without crossing a gap because these two curves connect each other. Two curves are C^1 continuous at the joining point if the first derivative does not change when crossing one curve to the other (Figure 6.12b).

Similarly, two curves are C^2 continuous at the joining point if, in addition to the first derivative, the second derivative is also the same when one curve is crossed to the other (Figure 6.12c).

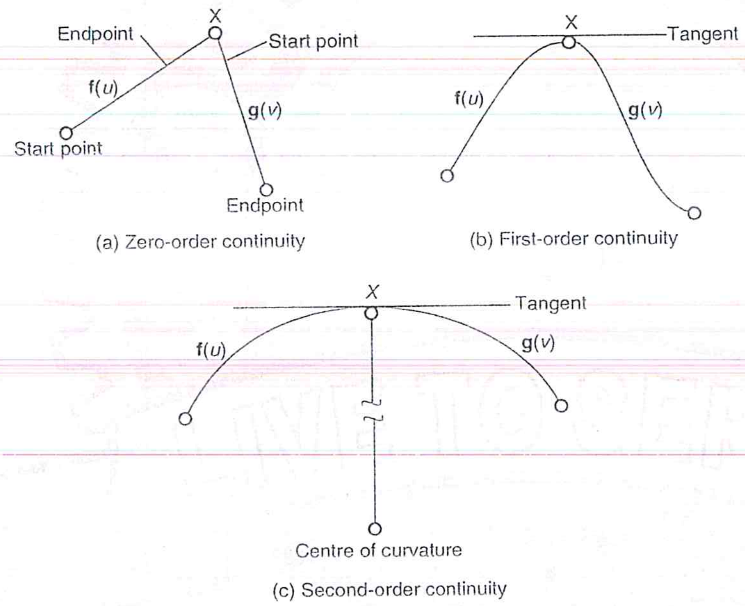


Fig. 6.12 Continuity of curves.

Therefore, C^1 continuous is 'smoother' than C^0 continuous at the joining point, C^2 continuous is 'smoother' than C^1 continuous at the joining point, and so on. Moreover, if the curvatures of the curves at the joining point are equal, we will say they are curvature continuous at the joining point. Intuitively, two curves are curvature continuous if the turning rate is the same at the joining

Q. NO.	ANSWER	MARKS

Ques 7

Parametric representation of analytic curves

* Parametric representation of curves is widely used in wireframe modelling. These parametric representations/equations and their developements are presented in vector form.

Lines :-

A line connecting two points P_1 and P_2.

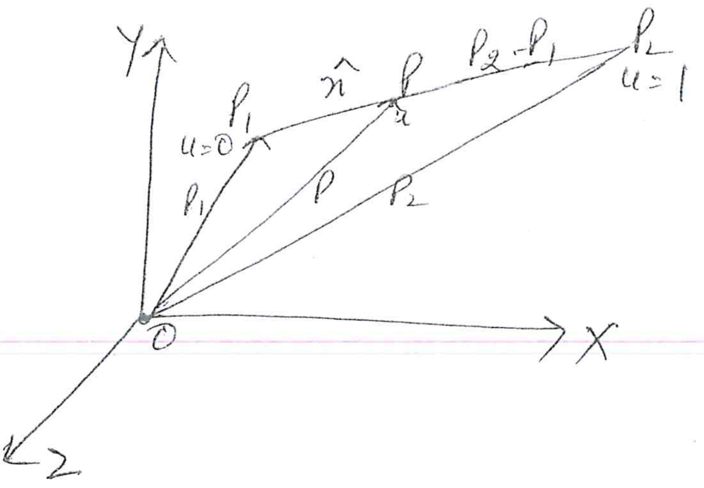
Define a parameter u such that u has the values 0 and 1 at P_1 and P_2 resp.

Utilizing the triangle OPP_1, the following equation can be written :-

$$P = P_1 + (P - P_1)$$

The vector $(P - P_1)$ is proportional to the vector $(P_2 - P_1)$ such that

$$P - P_1 = u(P_2 - P_1)$$



Q. NO.	ANSWER	MARKS

Thus the equation of the line becomes

$$P = P_1 + u(P_2 - P_1), \quad 0 \le u \le 1$$

In scalar form, this equation can be written as

$$\left.\begin{aligned} x &= x_1 + u(x_2 - x_1) \\ y &= y_1 + u(y_2 - y_1) \\ z &= z_1 + u(z_2 - z_1) \end{aligned}\right\} \quad 0 \le u \le 1$$

The tangent vector of the line is given by.

$$P' = P_2 - P_1$$

Or, in scalar form,

$$x' = x_2 - x_1$$
$$y' = y_2 - y_1$$
$$z' = z_2 - z_1$$

The unit vector $\hat{n}$ in the direction of the line is given by -

$$\hat{n} = \frac{P_2 - P_1}{L}$$

where $L = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$

$$\boxed{\hat{n} = \frac{P_2 - P_1}{\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}}}$$

$\boxed{P = P_1 + L\hat{n}}$ vector equation of line.

$L = |P - P_1|$

Q. NO.	ANSWER	MARKS

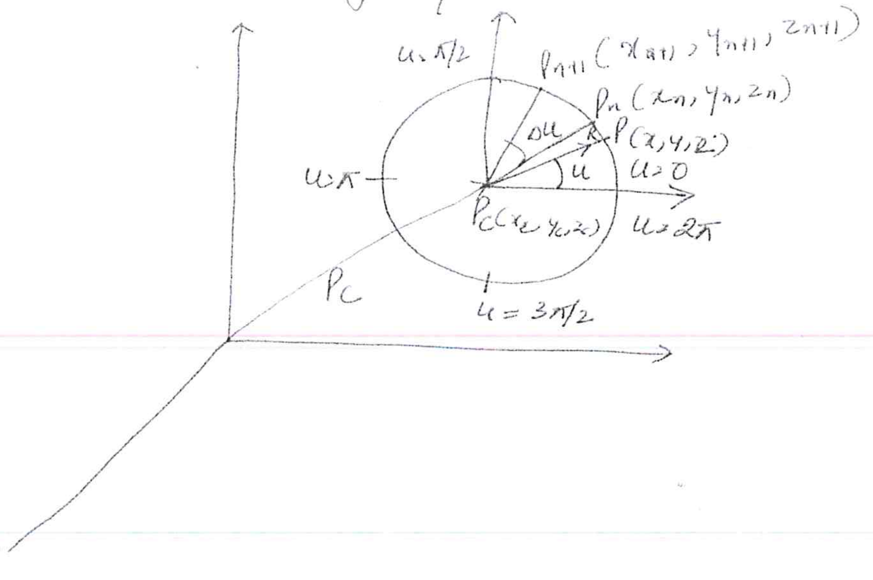
Circles :-

Circles and circular arcs are among the most common entities used in wireframe modelling. Circles and circular arcs together ith straight lines are sufficient to construct a percentage of existing mechanical parts and ponents in practice.

he basic parametric equation of a circle can written as :-

$$\left.\begin{aligned} x &= x_c + R\cos u \\ y &= y_c + R\sin u \\ z &= z_c \end{aligned}\right\} \quad 0 \le u \le 2\pi$$

uming that the plane of the circle is the XY plane r simplicity. The angle u is the angle measured om the X axis to any point P on the circle.



Q. NO.	ANSWER	MARKS
	Assuming there is an increment Δu between two consecutive points $P(x_n, y_n, z_n)$ and $P(x_{n+1}, y_{n+1}, z_{n+1})$ on the circle circumference, the following recursive relationship can be written:-	

$$x_n = x_c + R\cos u$$

$$y_n = y_c + R\sin u$$

Similarly

$$x_{n+1} = x_c + R\cos(u+\Delta u)$$

$$y_{n+1} = y_c + R\sin(u+\Delta u)$$

Expanding these equations gives :-

$$x_{n+1} = x_c + (x_n - x_c)\cos\Delta u - (y_n - y_c)\sin\Delta u$$

$$y_{n+1} = y_c + (y_n - y_c)\cos\Delta u + (x_n - x_c)\sin\Delta u$$

$$z_{n+1} = z_n$$

Thus, the circle can start from an arbitrary point and successive points with equal spacing can be calculated recursively. This algorithm is useful for hardware implementation to speed up the circle generation and display.

Q. NO.	ANSWER	MARKS

Ques 8

Example 3.3 A square (Fig 3.29) with an edge length of 10 units is located in the origin with one of the edges at an angle of 30° with the +*X*-axis. Calculate the new position of the square if it is rotated about the *Z*-axis by an angle of 30° in the clockwise direction.

Solution The end points of the edges are

$$dx_1 = 10 \times \cos 30° = 8.66$$

$$dx_2 = 10 \times \cos 30° - 10 \times \sin 30° = 3.66$$

$$dx_3 = 10 \times \cos 30° - dx_2 = 5$$

$$dy_1 = 10 \times \sin 30° = 5$$

$$dy_2 = dy_1 + 10 \times \sin 60° = 13.66$$

$$dy_3 = 10 \times \cos 30° = 8.66$$

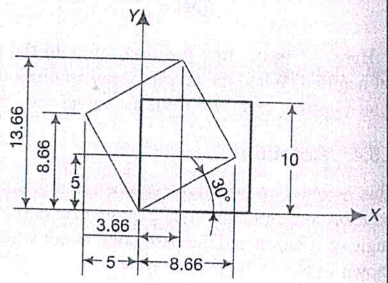


Fig. 3.29 *Example 3.3*

The transformation matrix is

$$[T_R] = \begin{bmatrix} \cos -30 & -\sin -30 \\ \sin -30 & \cos -30 \end{bmatrix} = \begin{bmatrix} 0.866 & 0.5 \\ -0.5 & 0.866 \end{bmatrix}$$

The new coordinates are

$$\begin{bmatrix} 0.866 & 0.5 \\ -0.5 & 0.866 \end{bmatrix} \begin{bmatrix} 0 & 0.866 & 3.66 & -5 \\ 0 & 5 & 13.66 & 8.66 \end{bmatrix} = \begin{bmatrix} 0 & 10 & 10 & 0 \\ 0 & 0 & 10 & 10 \end{bmatrix}$$

Q. NO.	ANSWER	MARKS

Note

1. Paper Setter is required to carefully write the answers for the questions, after consulting all the relevant books.
2. For any discripencies found in answers, paper setter will be held responsible for playing with the career of the students,and doing breach of trust with them, and accordingly action can be taken by the disiplinary committee in this regard.
3. Principal before signing for the correctness of the answer shall ensure the same from relevant books. Point No. 1 & 2 above are applicable to Principal also in case any discripencies are found in answers.

Dated 10/03/18 . **Signature of Paper Setter** **Signature of Principal/HOD**

Annexure No. SA/14

School of Aeronautics(Neemrana)

I-04, RIICO Industrial Area, Neemrana, Dist. Alwar, Rajasthan

Fortnightly/Term : Mid Term -1 Date : 26. 02. 2018

Subject : **Airlines & Airport Management (Th)** Batch : AE - 5&6

Faculty Name : Dr. V.S. Vajpai Semester: VIII

(Answer any FIVE Questions. All Questions carry equal marks) **Total Marks: 45**

Q.No.	Questions	Unit Name / Topic
1.	Write an essay on history of airline in India? (9)	Unit No.: Topic Name: Source:
2.	What do you understand by SWOT analysis? (9)	Unit No.: Topic Name: Source:
3.	What are the challenges faced by airline industry in India? (9)	Unit No.: Topic Name: Source:
4.	Justify the statement that planning an international airport is like planning a city. (9)	Unit No. Topic Name: Source:

Q.No.	Questions	Unit Name / Topic
5.	What is function of a terminal building? (9)	Unit No.: Topic Name: Source:
6.	Explain the process of design of a terminal building for an international Airport. (9)	Unit No.: Topic Name: Source:
7.	What do you understand by privatisation? (9)	Unit No.: Topic Name: Source:
8.	Explain the functions of Airport authority of India. (9)	Unit No. Topic Name: Source:

School of Aeronautics (Neemrana)
I-04, RIICO Industrial Area, Neemrana, Dist. Alwar, Rajasthan

MODEL ANSWER PAPER

Name of Examination: 1st Term Date of Examination: ______

Subject AAM - 8AN3 Batch S26 Semester 8.

Q. NO.	ANSWER	MARKS
1	The first aircraft was flown to India by JRD Tata who started the airline of India Today there are many national and International airlines flying passengers & cargo to and from India to various International destination Description of various airlines Discription of various aircrafts.	9
2.	SWOT stands for: S - Strength W - Weakness O - opportunities T - Threats. Explanation of all these terms.	9

Q. NO.	ANSWER	MARKS
3.	There are many airlines which are registered in India including Air India which is considered as the national carrier. Explaination of following threats. (a) Competition from other Indian airlines (b) Competition from International airlines (c) High cost of fuel (d) High Taxes (e) Capital intensive industry. (f) Heavy Airport landing and halting charges (g) Non-avaliability of slots in metro airports. etc.	9

Q. NO.	ANSWER	MARKS
4.	The Airports especially the International airports require all the provisions and facilities required by a city. Explanation of the provisions and facilities required by an International AirPort and comparation with the facility and provision required by a typical Indian city.	9
5.	The Airports have three sides. 1. Air Side 2. Terminal Building 3. Land Side. So the terminal building is a bridge between Air Side and Land Side. Full explanation of the statement.	9

Q. NO.	ANSWER	MARKS
6.	The process of design consists of three steps. Step One : Data Collection Step Two : Determination of future forecasts of the following (a) Passengers (b) Cargo (c) Aircraft inbound and outbound movements. (d) Forecast the demand based on (a), (b) and (c) Step Three : Start iterative process The terminal complex consists of the interface between aircraft travelers & various modes of landside transportation.	9

School of Aeronautics (Neemrana)

I-04, RIICO Industrial Area, Neemrana, Dist. Alwar, Rajasthan

Q. NO.	ANSWER	MARKS
Q7	It is the transfer of ownership of property and/or businesses from Government to privately owned entity Explanation of the following terms: Privatization Full Privatization Gradual & Partial Privatization Potential benefits Disadvantages of privatisation.	9
Q8.	DGCA is a regulatory authority whereas AAI is facilitator to aviation in India. AAI is responsible for creating, upgrading, maintaining and managing civil aviation infrastructure in India. It provides Air Traffic Management (ATM) services over Indian airspace & adjoining oceanic areas	9

Note

1. Paper Setter is required to carefully write the answers for the questions, after consulting all the relevant books.
2. For any discripencies found in answers, paper setter will be held responsible for playing with the career of the students,and doing breach of trust with them, and accordingly action can be taken by the disiplinary committee in this regard.
3. Principal before signing for the correctness of the answer shall ensure the same from relevant books. Point No. 1 & 2 above are applicable to Principal also in case any discripencies are found in answers

Dated 27.2.2018 Signature of Paper Setter Signature of Principal/HOD

Annexure No. SA/14

School of Aeronautics(Neemrana)

I-04, RIICO Industrial Area, Neemrana, Dist. Alwar, Rajasthan

Fortnightly/Term : Mid Term -1 Date : 26. 02. 2018

Subject : **Theory of Plate & Shells(Th)** Batch : AE - 5&6

Faculty Name : Mr. Ankit Luthra Semester: VIII

(Answer any FIVE Questions. All Questions carry equal marks) **Total Marks: 45**

Q.No.	Questions	Unit Name / Topic
1.	Derive the expression for 'twist of the surface' in pure bending of plates. (9)	Unit No.: Topic Name: Source:
2.	Derive the general differential equation for cylindrical bending of plates. (9)	Unit No.: Topic Name: Source:
3.	Derive expression for relation between bending moment and curvature in pure bending of plates. (9)	Unit No.: Topic Name: Source:
4.	Derive the expression for the deflection 'w' in case cylindrical bending of uniformly loaded rectangular plate with simply supported edges. (9)	Unit No. Topic Name: Source:

Q.No.	Questions	Unit Name / Topic
5.	Derive the differential equation of the deflection surface as obtained by Lagrange. (9)	Unit No.: Topic Name: Source:
6.	Write the assumptions required to develop a satisfactory approximate theory of bending of the plate by lateral loads for thin plates with small deflections. (9)	Unit No.: Topic Name: Source:
7.	What is the effect on stresses and deflections of small displacements of Longitudinal edges in the plane of the plate. (9)	Unit No.: Topic Name: Source:
8.	What is pure bending? (9)	Unit No. Topic Name: Source:

Annexure No. SA/35

School of Aeronautics (Neemrana)

I-04, RIICO Industrial Area, Neemrana, Dist. Alwar, Rajasthan

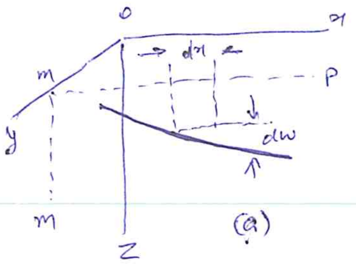
MODEL ANSWER PAPER

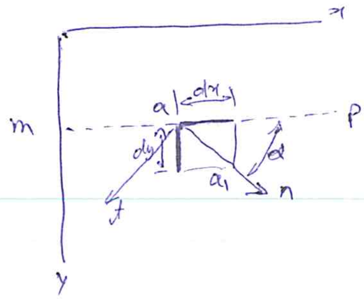
Name of Examination: Mid Term - 1 Date of Examination: 26.2.2018

Subject: Theory of Plates and Shells Batch: 5 Semester: 08

Q. NO.	ANSWER	MARKS
01	Derive the expression for 'twist of the surface' in pure bending of plates.	
Ans	In discussing small deflections of a plate we take the middle plane of the plate, before bending occurs as the xy plane. During bending, the particles that were in the xy plane undergo small displacement w perpendicular to the xy plane and form the middle surface of the plate. These displacements of the middle surface are called deflections of a plate in our further discussion. Taking a normal section of the plate parallel to the xz plane (Fig a), we find that the slope of the middle surface in the x direction is $i_x = \partial w/\partial x$. In the same manner the slope in the y direction is $i_y = \partial w/\partial y$. Taking now any direction an in the xy plane (fig b) making an angle α with the x-axis, we find that the difference in the deflections of the two adjacent points a and a_1 in the an direction is $$dw = \frac{\partial w}{\partial x} dx + \frac{\partial w}{\partial y} dy$$	

Q. NO.	ANSWER	MARKS





and that the corresponding slope is

$$\frac{\partial w}{\partial n} = \frac{\partial w}{\partial x}\frac{dx}{dn} + \frac{\partial w}{\partial y}\frac{dy}{dn} = \frac{\partial w}{\partial x}\cos\alpha + \frac{\partial w}{\partial y}\sin\alpha \qquad (a)$$

To find the direction α_1 for which the slope is a maximum we equate to zero the derivative with respect to α of expression (a). In this way we obtain

$$\tan\alpha_1 = \frac{\partial w}{\partial y} \Big/ \frac{\partial w}{\partial x} \qquad (b)$$

Substituting the corresponding values of $\sin\alpha_1$ and $\cos\alpha_1$ in (a), we obtain for the maximum slope the expression

$$\left(\frac{\partial w}{\partial n}\right)_{max} = \sqrt{\left(\frac{\partial w}{\partial x}\right)^2 + \left(\frac{\partial w}{\partial y}\right)^2} \qquad (c)$$

By setting expression (a) equal to zero we obtain the direction for which the slope of the surface is zero. The corresponding angle α_2 is determined from the equation

$$\tan\alpha_2 = -\frac{\partial w}{\partial x} \Big/ \frac{\partial w}{\partial y} \qquad (d)$$

From equations (b) and (d) we conclude that

$$\tan\alpha_1 \tan\alpha_2 = -1$$

Q. NO.	ANSWER	MARKS

The curvature of the surface in a plane parallel to the xz plane is then numerically equal to

$$\frac{1}{r_x} = -\frac{\partial}{\partial x}\left(\frac{\partial w}{\partial x}\right) = -\frac{\partial^2 w}{\partial x^2}$$

In the same manner we obtain for the curvature in a plane parallel to the yz plane

$$\frac{1}{r_y} = -\frac{\partial}{\partial y}\left(\frac{\partial w}{\partial y}\right) = -\frac{\partial^2 w}{\partial y^2}$$

In considering the curvature of the middle surface in any direction an we obtain

$$\frac{1}{r_n} = -\frac{\partial}{\partial n}\left(\frac{\partial w}{\partial n}\right)$$

Substituting expression (a) for $\partial w/\partial n$ and observing that

$$\frac{\partial}{\partial n} = \frac{\partial}{\partial x}\cos\alpha + \frac{\partial}{\partial y}\sin\alpha$$

We find

$$\frac{1}{r_n} = -\left(\frac{\partial}{\partial x}\cos\alpha + \frac{\partial}{\partial y}\sin\alpha\right)\left(\frac{\partial w}{\partial x}\cos\alpha + \frac{\partial w}{\partial y}\sin\alpha\right)$$

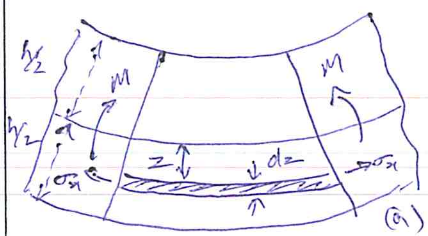
$$= -\left(\frac{\partial^2 w}{\partial x^2}\cos^2\alpha + 2\frac{\partial^2 w}{\partial x\partial y}\sin\alpha\cos\alpha + \frac{\partial^2 w}{\partial y^2}\sin^2\alpha\right)$$

$$= \frac{1}{r_x}\cos^2\alpha - \frac{1}{r_{xy}}\sin 2\alpha + \frac{1}{r_y}\sin^2\alpha$$

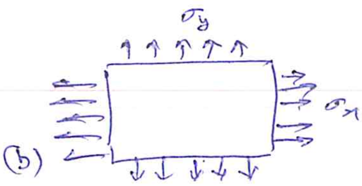
Q. NO.	ANSWER	MARKS
	It is seen that the curvature in any direction n at a point of the middle surface can be calculated if we know at that point the curvatures	
	$\frac{1}{r_x} = -\frac{\partial^2 w}{\partial x^2}$ $\frac{1}{r_y} = \frac{-\partial^2 w}{\partial y^2}$ and the quantity	
	$\frac{1}{r_{xy}} = \frac{\partial^2 w}{\partial x \partial y}$ which is called the twist of the surface with respect to the x and y axes.	
Q2	Derive the general expression differential equation for cylindrical bending of plates.	
ans	Consider a plate of uniform thickness, equal to h, and take the xy plane as the middle plane of the plate before loading, i.e., as the plane midway between the faces of the plate. Let the y axis coincide one of the longitudinal edges of the plate and let the positive direction of the z axis be downward. Then if the width of the plate is denoted by l, the elemental strip may be considered as a bar of rectangular cross section which has a length l and a depth of h. In calculating the bending stresses in such a bar we assume, as in the ordinary theory of beams, that cross sections of the bar remain plane during bending, so that they undergo only a rotation with respect to their neutral axes. If no normal forces are applied to the end sections of the plate, and the unit elongation of a fiber parallel to the x axis is proportional	

Q. NO.	ANSWER	MARKS

to its distance z from the middle surface. The curvature of the deflection curve can be taken equal to $-\partial^2 w/\partial x^2$, where w, the deflection of the bar in the z direction, is assumed to be small compared with the length of the bar l. The unit elongation ϵ_x of a fiber at a distance z from the middle surface is then $-z\,\partial^2 w/\partial x^2$. Making use of Hooke's law, the unit elongation ϵ_x and ϵ_y in terms of the normal stresses σ_x and σ_y acting on the element shown shaded in fig (a) are



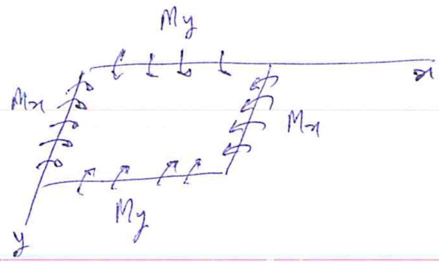
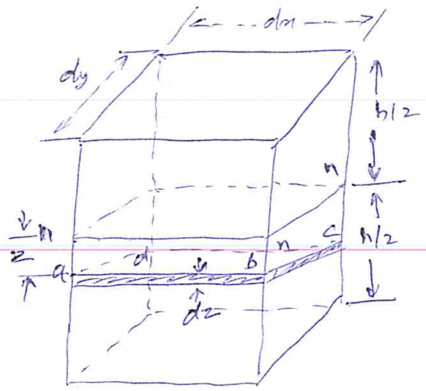
$$\epsilon_x = \frac{\sigma_x}{E} - \nu\frac{\sigma_y}{E}$$
$$\epsilon_y = \frac{\sigma_y}{E} - \nu\frac{\sigma_x}{E} = 0 \qquad (1)$$



where E is the modulus of elasticity of the material and ν is Poisson's ratio. The lateral strain in the y direction must be zero in order to maintain continuity in the plate during bending, from which it follows by the second of the equations (1) that $\sigma_y = \nu\sigma_x$. Substituting this value in the first of the equations (1), we obtain

$$\epsilon_x = \frac{(1-\nu^2)\sigma_x}{E} \quad \text{and} \quad \sigma_x = \frac{E\epsilon_x}{1-\nu^2} = \frac{-Ez}{1-\nu^2}\frac{d^2w}{\partial x^2}$$

If the plate is submitted to the action of tensile or compressive forces acting in the x direction and uniformly distributed along the longitudinal sides of the plate, the corresponding direct stress must be added to the stress (2) due to bending. Having the expression for bending stress σ_x, we obtain by integration the bending moment in the elemental strip:

Q. NO.	ANSWER	MARKS
	$M = \int_{-h/2}^{h/2} \sigma_x z \, dz = -\int_{-h/2}^{h/2} \frac{Ez^2}{1-\nu^2} \frac{d^2w}{dx^2} dz = -\frac{Eh^3}{12(1-\nu^2)} \frac{d^2w}{dx^2}$	
	Introducing the notation $\frac{Eh^3}{12(1-\nu^2)} = D$, we represent the equation for the deflection curve of the elemental strip in the following form.	
	$D \frac{d^2w}{dx^2} = -M$	
03	Derive the expression for relation between the bending moment and curvature in pure bending of plates.	
	 	
	Combination of such bending in two perpendicular directions brings us to pure bending of plates. We denote by M_x the bending moment per unit length acting on the edges parallel to the y axis and by M_y the moment per unit length acting on the edges parallel to the x axis.	
	Let $\frac{1}{r_x}$ and $\frac{1}{r_y}$ denote, as the curvatures of the neutral surface in sections parallel to the xz and yz planes, respectively.	
	Then the unit elongations in the x and y directions of an elemental lamina abcd at a distance z from the neutral surface, are found as in the case of a beam, and are equal to	

Q. NO.	ANSWER	MARKS

$$\epsilon_x = \frac{z}{r_x} \qquad \epsilon_y = \frac{z}{r_y} \qquad (a)$$

Using Hooke's law, the corresponding stresses in the lamina abcd are

$$\sigma_x = \frac{Ez}{(1-\nu^2)}\left(\frac{1}{r_x} + \nu\frac{1}{r_y}\right) \quad -(b)$$

$$\sigma_y = \frac{Ez}{(1-\nu^2)}\left(\frac{1}{r_y} + \nu\frac{1}{r_x}\right)$$

These stresses are proportional to the distance z of the lamina abcd from the neutral surface and depend on the magnitudes of curvatures of the bent plate. The normal stresses distributed over the lateral sides of the element can be reduced to couples, the magnitudes of which per unit length evidently must be equal to the external moments M_x and M_y. In this way we obtain the equations

$$\int_{-h/2}^{h/2} \sigma_x z\,dz = M_x \qquad \int_{-h/2}^{h/2} \sigma_y z\,dz = M_y$$

Substituting expressions (b) for σ_x and σ_y, we obtain

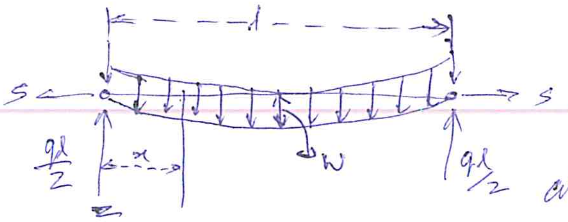
$$M_x = D\left(\frac{1}{r_x} + \nu\frac{1}{r_y}\right) = -D\left(\frac{\partial^2 w}{\partial x^2} + \nu\frac{\partial^2 w}{\partial y^2}\right)$$

$$M_y = D\left(\frac{1}{r_y} + \nu\frac{1}{r_x}\right) = -D\left(\frac{\partial^2 w}{\partial y^2} + \nu\frac{\partial^2 w}{\partial x^2}\right)$$

04 Derive the expression for the deflection 'w' in case of cylindrical bending of uniformly loaded rectangular plate with simply supported edges

Ans. Let us consider a uniformly loaded long rectangular plate with longitudinal edges which are free to rotate but cannot move toward each other during bending. An element al strip

Q. NO.	ANSWER	MARKS
	cut out of this plate, as shown in the figure, is in the condition of a uniformly loaded bar submitted to the action of an axial force S. The magnitude of S is such as to prevent the ends of the bar from moving along the x axis.	



Denoting by q the intensity of the uniform load, the bending moment at any cross section of the strip is $M = \frac{ql}{2}x - \frac{qx^2}{2} - Sw$. Substituting in $D\frac{d^2w}{dx^2} = -M$, we obtain

$$\frac{d^2w}{dx^2} - \frac{Sw}{D} = -\frac{qlx}{2D} + \frac{qx^2}{2D} \quad -(a)$$

introducing the notation $\frac{Sl^2}{D4} = u^2$. The general solution of equation (a) can be written in the following form:

$$w = C_1 \sinh\frac{2ux}{l} + C_2\cosh\frac{2ux}{l} + \frac{ql^3x}{8u^2D} - \frac{ql^2x^2}{8u^2D} - \frac{ql^4}{16u^4D}$$

The constants of integration C_1 and C_2 will be determined from the conditions at the ends. Since the deflections of the strip at the ends are zero, we have

$w = 0$ for $x = 0$ and $x = l$.

After substitution, we can represent the expression as:

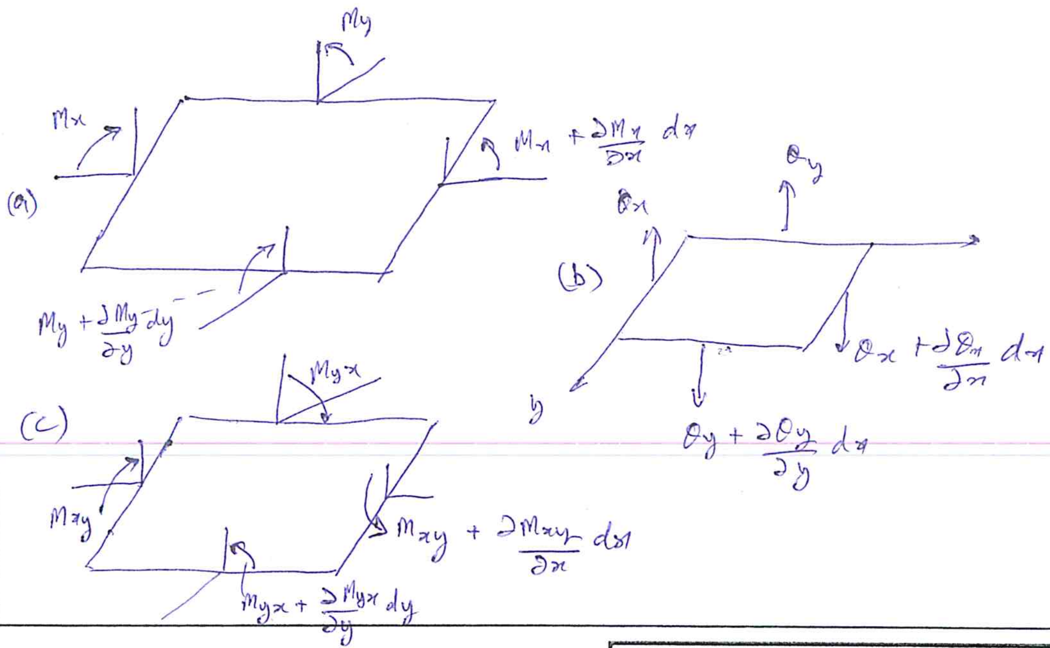
$$w = \frac{ql^4}{16u^4D}\left[\frac{\cosh u\left(1 - \frac{2x}{l}\right)}{\cosh u} - 1\right] + \frac{ql^2x}{8u^2D}(l - x)$$

Q. NO.	ANSWER	MARKS
05	Derive the differential equation of the deflection surface as obtained by Lagrange.	

Ans Assuming no strain in the middle plane of the plate during bending. In addition to the bending moments M_x and M_y and the twisting moments M_{xy}, there are vertical shearing forces acting on the sides of the element. The magnitudes of these shearing forces per unit length parallel to the y and x axes we denote by Q_x and Q_y, respectively, so that

$$Q_x = \int_{-h/2}^{h/2} \tau_{xz}\, dz \qquad Q_y = \int_{-h/2}^{h/2} \tau_{yz}\, dz$$

. Since the moments and the shearing forces are functions of the coordinates x and y, we must, in discussing the conditions of equilibrium of the element, take into consideration the small changes of these quantities, when the coordinates x and y change by small quantities dx and dy. The middle plane of the element is represented in the figure.



Q. NO.	ANSWER	MARKS
	Projecting all the forces on the element onto the z axis we obtain the following equation of equilibrium:	
	$\frac{\partial Q_x}{\partial x} + \frac{\partial Q_y}{\partial y} + q = 0$	
	Taking moments of all the forces acting on the element with respect to the x axis and y axis. The moment of the load q and the moment due to change in the force Q_y are neglected. After simplification	
	$\frac{\partial M_{xy}}{\partial x} - \frac{\partial M_y}{\partial y} + Q_y = 0$ and $\frac{\partial M_{yx}}{\partial y} + \frac{\partial M_x}{\partial x} - Q_x = 0$	
	Eliminating Q_x and Q_y, we obtain	
	$\frac{\partial^2 M_x}{\partial x^2} + \frac{\partial^2 M_y}{\partial y^2} - 2\frac{\partial^2 M_{xy}}{\partial x \partial y} = -q$	
	Using the relations $M_x = -D\left(\frac{\partial^2 w}{\partial x^2} + \nu\frac{\partial^2 w}{\partial y^2}\right)$	
	$M_y = -D\left(\frac{\partial^2 w}{\partial y^2} + \nu\frac{\partial^2 w}{\partial x^2}\right)$ and $M_{xy} = -M_{yx} = D(1-\nu)\frac{\partial^2 w}{\partial x \partial y}$	
	substituting these expressions, we obtain	
	$\frac{\partial^4 w}{\partial x^4} + \frac{2\partial^4 w}{\partial x^2 \partial y^2} + \frac{\partial^4 w}{\partial y^2} = \frac{q}{D}$	
06	Write the assumptions required to develop a satisfactory approximate theory of bending of the plate by lateral loads for thin plates with small deflections.	

Q. NO.	ANSWER	MARKS
Ans	If the deflections w of a plate are small in comparison with its thickness h, a very satisfactory approximate theory of bending of the plate by lateral loads can be developed by making the following assumptions: 1. There is no deformation in the middle plane of the plate. This plane remains neutral during bending. 2. Points of the plate lying initially on a normal-to-the-middle plane of the plate remain on the normal-to-the-middle surface of the plate after bending. 3. The normal stresses in the direction transverse to the plate can be disregarded.	
Q7	What is the effect of on stresses and deflections of small displacements of longitudinal edges in the plane of the plate.	
Ans	Assuming that during bending, the longitudinal edges undergo a displacement toward each other specified by Δ. Owing to this displacement the extension of the elemental strip will be diminished by the same amount, and the equation for calculating the tensile force S becomes $$\frac{Sl(1-\nu^2)}{hE} = \frac{1}{2}\int_0^l \left(\frac{dw}{dx}\right)^2 dx - \Delta \qquad \text{— (a)}$$	

Q. NO.	ANSWER	MARKS

At the same time equations

$$w = \frac{ql^4}{16u^4 D}\left[\frac{\cosh u\left(1-\frac{2x}{l}\right)}{\cosh u} - 1\right] + \frac{ql^2 x}{8u^2 D}(l-x) \quad \text{(Simply supported edges)}$$

$$w = \frac{ql^4}{16u^3 D \tanh u}\left\{\frac{\cosh\left[u\left(1-\frac{2x}{l}\right)\right]}{\cosh u} - 1\right\} + \frac{ql^2(l-x)x}{8u^2 D}$$

(built in edges)

for the deflection curve hold true regardless of the magnitude of the tensile forces. They may be differentiated and substituted under the integral sign in equation (a). After evaluating this integral and substituting $S = 4u^2 D/l^2$, we obtain for simply supported edges

$$\frac{E^2 h^8}{q^2(1-\nu^2)^2 l^8} * \frac{u^2 + \frac{3l\Delta}{h^2}}{u^2} = U_0$$

and for built-in edges

$$\frac{E^2 h^8}{q^2(1-\nu^2)^2 l^8} * \frac{u^2 + \frac{3l\Delta}{h^2}}{u^2} = U_1$$

If Δ is made zero, the above equations reduce to equations for immovable edges.

Q. NO.	ANSWER	MARKS
08	What is pure bending?	
Ans	Pure bending is a condition of stress where a bending moment is applied to a beam without the simultaneous presence of axial, shear, or torsional forces. Pure bending occurs only under a constant bending moment (M) since the shear force (V), which is equal to, has to be equal to zero. Thus, the zero shear force means that the bending moment is constant as the bending is same at every cross-section of the beam. Such a situation may be visualised or envisaged when the beam or some portion of the beam, as been loaded only by pure couples at its ends.	

Note

1. Paper Setter is required to carefully write the answers for the questions, after consulting all the relevant books.
2. For any discripencies found in answers, paper setter will be held responsible for playing with the career of the students,and doing breach of trust with them, and accordingly action can be taken by the disiplinary committee in this regard.
3. Principal before signing for the correctness of the answer shall ensure the same from relevant books. Point No. 1 & 2 above are applicable to Principal also in case any discripencies are found in answers

Dated 22-2-2018. Signature of Paper Setter Signature of Principal/HOD

Annexure No. SA/14

School of Aeronautics(Neemrana)

I-04, RIICO Industrial Area, Neemrana, Dist. Alwar, Rajasthan

Fortnightly/Term : Mid Term -1 Date : 26. 02. 2018

Subject : **Maintenance of Power Plant system (Th)** Batch : AE - 5&6

Faculty Name : Mr. Arjun singh Semester: VIII

(Answer any FIVE Questions. All Questions carry equal marks) **Total Marks: 45**

Q.No.	Questions	Unit Name / Topic
1.	Describe the construction and function of axial flow compressor. (9)	Unit No.: Topic Name: Source:
2.	What do you under stand about single spool and two spool axial compressor. (9)	Unit No.: Topic Name: Source:
3.	What are the type of centrifugal compressor? Explain. (9)	Unit No.: Topic Name: Source:
4.	What is the principle of centrifugal compressor operation? Explain. (9)	Unit No. Topic Name: Source:

Q.No.	Questions	Unit Name / Topic
5.	What are the types of combustion chambers? Explain. (9)	Unit No.: Topic Name: Source:
6.	Explain multiple chamber (Cannular) type combustion Chamber. (9)	Unit No.: Topic Name: Source:
7.	Explain the construction and working of annular comb chamber and what are its advantages. (9)	Unit No.: Topic Name: Source:
8.	Explain the construction and working of turbo annular (can annular) type comb chamber. (9)	Unit No. Topic Name: Source:

Annexure No. SA/35

School of Aeronautics (Neemrana)

I-04, RIICO Industrial Area, Neemrana, Dist. Alwar, Rajasthan

MODEL ANSWER PAPER

Name of Examination: 1st Mid Term. Date of Examination: ______

Subject: Maint of Powerplant & Sys. Batch: 526 Semester: VIII

Q. NO.	ANSWER	MARKS
1.	Axial flow compressor have the entry guide vanes, stator blades and rotor blades. Entry guide vane direct the incomming air at approperate angle and rotor blades imparts valocity to air. The stator blades converts air valocity to pressure. The air path through rotor blades are convergent where as through stator blades it is divergent. One stator and one rotor blades makes one stage of compressor. Since valocity increases and decreases at equal amount but decreases pressure decreases lesser then decrease pressure increases at each stage. Hence pressure increases stage by stage approximally 1 : 1·3.	9 (7½)
2.	Single spool Axial flow compressor is the one which posses one compressor rotor, one shaft and turbine. There is limitation to increase the number of stages since axial flow compressor is more prone to surge. In certain earlier engines number of stages were	

SECTION	: 12	PAGE NO.	: 147
ISSUE NO.	: I	ISSUE DATE	: 01.08.12
REVISION NO.	: 0	REV. DATE	: -

Q. NO.	ANSWER	MARKS
	increased upto 15 stages but ~~On the~~ on those engines anti-Surge Systems such as bleed valves and variable angle stator blades were designed.	
	In later gas turbine engines to design more powerfull engines by increased the number of stages compressors employing twin spool compressors. In twin spool engines, there are two compressors i.e. Low pressure compressor and high pressure compressor. Each compressor have it's own shaft arranged co-axially and independant turbine. Both compressors are rotated at different r.p.ms which eliminate the ~~can~~ chances of surge.	9 (7½)
3.	There are basically three types of centrifugal compressor i.e. a. Single Sided b. Two Sided c. Shrouded type. Single sided centrifugal compressor have the vanes ~~one~~ on single side of the disc. Air travels from eye of the impeller and folow the divergent path between two adjascent vanes	

Q. NO.	ANSWER	MARKS
	and impart the high valocity and some pressure due to its divergent flow and discharge the air towards its periphery.	
	Two sided centrifugal compressor have vanes at both sides of disc. hence displacing Large amount of air with high valocity. Air flows in the same manner from both sides. Certain amount of air which does not flow between the impellar vanes slips to diffusor casing, which is loss of compressor	
	The shrouded type of centrifugal compressor is used on small engines such as Turbo starter, GPU etc. The shroud minimise the slip losses.	
	The diffusor casing consists of diffusor vanes around the perphery of impellar. The function of these vanes is to stall the air valocity and convert into pressure and direct the air to combustion chamber through air outlet casing.	9 7½
4	The principles of operation of Centrifugal compressor is that the impellar is rotated at high speed by turbine and air is continueously induced into the centre of impellar. centrifugal causes it to flow radially out-wards along the vanes to impellar tip, Thus	

Q. NO.	ANSWER	MARKS
	accelerating the air and also causing a slight rise in pressure to occur. The engine intake duct contain vanes that provide initial whirl to air entering into compressor	
	The air from impellar passes into the diffusor section where it passages from the divergent nozzles and converts most of the kinetic energy into pressure energy. In practice, it is usual to design the compressor so that about half of the pressure occur in impellar and half in the diffuser.	
	The air mass flow and pressure rise depend up on the rotational speed of impellar. To maintain the efficiency of compressor, it is necessary to prevent excessive air leakage between the impellar and casing, This is achieved by keeping there clearances as small as possible.	9 (7½)
5.	There are three main types of combustion chambers, they are mulitple type, the turbo-annular chamber and annular chamber	
	Multiple type is used on centrifugal compressor engines and earlier type of axial flow compressor engines.	
	The chambers are disposed around the engine and compressor delivery air is directed by ducts to pass into the individual chamber. Each chamber has an inner flame tube around which there is casing. The air passes through the flame tube snout and also between the flame tube and the outer casing.	
	The seperate flame tubes are all inter connected. This allows each tube to operate at the same pressure and propagate the flame to tubes during starting.	

Q. NO.	ANSWER	MARKS
	The turbo annular c.c. is a combination of multiple and annular type. A number of flame tubes are fitted inside a common air casing. The airflow is similar as described above.	
	The annular C.C. consists a single flame tube which is contained in an inner and outer casing. The airflow through the flame tube is similar and mentioned above. The main advantage of this chamber is that, for the same power out put, its length is shorter resulting in reduction in cooling air, weight and cost.	9 7½
6.	Multiple cc is used on centrifugal compressor engines and early type of axial flow engines. It is the direct development of earlier type of whittle type combustion chamber. The major difference is that whittle chamber had a reverse flow, but as this created a ~~cond~~ considerable pressure loss, the straight flow multi chamber was devloped by Joseph Lucas Ltd.	
	The chambers are desposed around the engine. The air passes through the flame tube front and also between the tube and casing.	

Note

1. Paper Setter is required to carefully write the answers for the questions, after consulting all the relevant books.
2. For any discripencies found in answers, paper setter will be held responsible for playing with the career of the students,and doing breach of trust with them, and accordingly action can be taken by the disiplinary committee in this regard.
3. Principal before signing for the correctness of the answer shall ensure the same from relevant books. Point No. 1 & 2 above are applicable to Principal also in case any discripencies are found in answers

Dated ____________ . Signature of Paper Setter Signature of Principal/HOD

Q. NO.	ANSWER	MARKS
	The separate flame tubes are all inter-connected. This allows all tubes to operate at the same temperature & pressure and also allows the combustion to propagate around the flame tubes during starting.	9 (7½)
7	This type of combustion chamber consists of a single flame tube completely annular in form, which is contained in inner and outer casing. The air flow through the flame tube is annular	
	The main advantage of annular chamber is that for the same power output the length of the chamber is only 75% of that of turbo-annular system of the same diameter resulting in considerable saving in weight and production cost.	
	The wall area of annular c.c. is much less consequently the amount of cooling air to cool the flame tube is also required less. The reduction in cooling air raises the combustion efficiency which virtually eliminates unburnt fuel and oxidizes the carbon monoxide to non toxic carbon dioxide thus reducing pollution.	
	A high by pass ratio engine will also reduce air pollution since for a given thrust the engine burns less fuel.	9 (7½)

Annexure No. SA/35

School of Aeronautics (Neemrana)

I-04, RIICO Industrial Area, Neemrana, Dist. Alwar, Rajasthan

MODEL ANSWER PAPER

Name of Examination: ____________ Date of Examination: ____________

Subject ____________ Batch ________ Semester ________

Q. NO.	ANSWER	MARKS
8.	The turbo annular C.C. is a combination of multiple and annular types. A number of flame tubes are fitted inside a common air casing. The air flow is directed to pass into individual flame tube around which there is a common air casing. The air passes through the flame tube snout and also between the flame tube and outer casing. This embodies the ease of overhaul and testing of the multiple system with the compactness of annular system.	9 7.5

Arjun
(ARJUN SINGH)

6/3/18
(Dr. Birendra Rai)