SET- 1

Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: Theory of Plates — **Semester: VI**
Program: B. Tech ASE — **Time 03 hrs.**
Course Code: ASEG 352 — **Max. Marks: 100**

Instructions: a) All questions are compulsory.
b) Assume the missing data.

SECTION A

S. No.		Marks	CO
Q 1	State the kinematics assumption of classical plate theory.	**4**	**CO1**
Q 2	Define the geometric and natural boundary conditions for a square plate if all edges are a) Simply supported b) Clamped.	**4**	**CO1**
Q 3	State the principal of minimum potential energy (PMPE). Is PMPE applicable for all type of non-linear problems?	**4**	**CO4**
Q 4	Express the polynomial form of the kinematically admissible displacement function for SSSS and CSCS supported square plates.	**4**	**CO2**
Q 5	Give reason for following questions a) Square plate subjected to a concentrated load at the center is not an axisymmetric problem. b) In case of pure bending of plate, shear curvature is zero.	**4**	**CO4**

SECTION B

Q 6	Convert the $\frac{\partial^2}{\partial y^2}$ in polar form.	**10**	**CO3**
Q 7	Express the strain energy of the plate as function of displacement.	**10**	**CO3**
Q 8	a) Draw the free body diagram of plate subjected to the uniform distributed load q_0. b) Derive the equilibrium equation of the plate.	**10**	**CO1**
Q 9	A simply supported square plate, $(0 \le x, y \le a)$, subjected to uniformly distributed load given by $100\, N/m^2$ on its transverse surface. Determine the Navier solution for the displacement of the plate. Restrict the series solution to three term. Use following relation to obtained the displacement amplitude of the problem. $a_{mn} = \frac{4}{a^2} \iint_0^a q(x,y) \sin\frac{m\pi x}{a} \sin\frac{n\pi y}{a}\, dxdy$ **OR**	**10**	**CO2**

	A square plate $(0 \leq x, y \leq a)$, simply supported at $x=0$ and $x=a$, and clamped at the other two edges. Apply Rayleigh-Ritz method to determine the natural frequency of the plate under free vibration.		
	SECTION-C		
Q 10	Write down the governing equation of the plate for free vibration. Determine the natural frequency for the simply supported edged using Naiver approach. Also, a) Draw the first two fundamental mode of vibration. b) Find out the percentage change in the frequency if the elastic modulus is reduced by half.	**20**	**CO4**
Q 11	The general solution of mid plane displacement of circular plate of radius $r=a$and thickess h subjected to the end moment M_0 is given by $w=c1\ln(r)+c2r^2\ln(r)+c3r^2+c4$ a) Determine the mid plane displacement form of circular plate if the edge of plateis simply supported. b) Determine the maximum displacement value of the circular plate. c) Calculate the percentage change in deflection value if the thickness of the plate is doubled. **OR** A square plate $(0 \leq x, y \leq a)$, clamped at all edges and subjected to uniform distributed load $q(x,y)=50\,N/m^2$. Apply Rayleigh-Ritz (R-R) method to determine a) Maximum displacement position and magnitude. b) If the exact value of maximum displacement obtained from Navier's solution is $w_{max}(exact)=1.01\frac{a^4}{D}$, then determine the percentage change in the solution obtained from R-R method. c) Calculate the percentage change in $w_{max}(¿.)$ if the thickness of the plate is reduced by half.	**20**	**CO2**

SET- 2

Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: Theory of Plates **Semester: VI**
Program: B. Tech ASE **Time 03 hrs.**
Course Code: ASEG 352 **Max. Marks: 100**

Instructions: **a) All questions are compulsory.**
b) Assume the missing data.

SECTION A

S. No.		Marks	CO
Q 1	Write down the kinematics equations of plate.	**4**	**CO1**
Q 2	Define axi-symmetric problem, support your answer with an example.	**4**	**CO1**
Q 3	Differentiate between the Rayleigh-Ritz and Galerkin method for static analysis of plates. Is Rayleigh-Ritz method applicable for all non-linear problems.	**4**	**CO4**
Q 4	Write the kinematically admissible displacement form for SCSC and CCCC supported square plates.	**4**	**CO2**
Q 5	Distinguish between plate and shell structure.	**4**	**CO4**

SECTION B

Q 6	Derive the equilibrium equations of shell under bending.	**10**	**CO3**
Q 7	Write down the strain energy of the plate as function of displacement.	**10**	**CO3**
Q 8	A square plate of side a, subjected to preesure p_0 on its transverse surface. a) Draw a free body diagram and clearly show all the stress resultant and stress couples. b) Write down the kinematic (Strain-displacement) and constitutive equations (stress-strain relation) of the plates.	**10**	**CO1**
Q 9	A simply supported square plate, $(0 \le x, y \le a)$, subjected to uniformly distributed load given by $q(x, y) = q_0$,on its transverse surface. Determine the Navier solution for the displacement of the plate. Restrict the series solution to three term. Use following relation to obtained the displacement amplitude of the problem. $a_{mn} = \frac{4}{a^2} \iint_0^a q(x, y) \sin \frac{m\pi x}{a} \sin \frac{n\pi y}{a} dxdy$ **OR**	**10**	**CO2**
	A square plate $(0 \le x, y \le a)$, simply supported at $x=0$ and $x=a$, and clamped at the other two edges. Apply Rayleigh-Ritz method to determine maximum displacement position and magnitude.		**CO2**

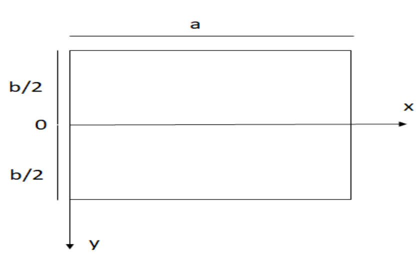
SECTION-C			
Q 10	Distinguish between exact and approximate analysis. Applying Rayleigh –Ritz method to determine the maximum displacement of square plate of side a, which is simply supported at all edges and subjected to sinusoidal loading given by, $$q(x,y)=q_o\frac{\sin(\pi x)}{a}\frac{\sin(\pi y)}{a}$$	**20**	**CO4**
Q 11	The general solution of mid plane displacement of circular plate of radius $r=a$and thickess h subjected to the uniform distributed load $q(x,y)=q_0$ $$w=c1\ln(r)+c2r^2\ln(r)+c3r^2+c4+\frac{q_0r^4}{64D}$$ Where, $D=\frac{Eh^3}{12(1-\mu^2)}$. a) Obtain the mid plane displacement form of circular plate if the edge of plate is simply supported. b) Determine the maximum displacement value of the circular plate. c) Calculate the percentage change in deflection value if the radius is doubled. **OR** The general solution of governing equation, $\nabla^4 w=\frac{q}{D}$ for the rectangular plate, shown in Fig. 1, subjected to uniform transverse load $q=q_o$ by Levy's method is given by the sum of the solution of complementary and particular integral part, such that $$w_c=\sum_{m=1}^{m=\infty} ¿¿$$ $$w_p=\frac{4q_oa^4}{\pi^5D}\sum_{m=1}^{m=\infty}\frac{1}{m^5}\sin\frac{m\pi x}{a}$$ Wherew_c, w_p are complementary and particular part of the general solution and , $D=\frac{Eh^3}{12(1-\mu^2)}$ a) Obtain the solution for the mid plate displacement, if all the edges are simply supported.  	**20**	**CO2**

	Fig. 1 b) Using the above solution find out the maximum displacement value if $a = b = 1$ and $\mu = 0.25$		