Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

Previous Semester Examination December 2019

Program: B. Tech Mechanical **Duration: 3 Hour**

Course Code: PCC-BTM601/BTM601(New /Old course) **Maximum Points: 100**

Course Name: Refrigeration and Air-Conditioning. **Semester: VI**

Instructions:

1) Question no.1 is compulsory and solve any four questions out of remaining six.
2) Use of refrigerant properties and psychrometric chart is permitted.
3) Use of steam table is permitted.
4) Assume suitable data and justify the same.

Q.No.	Questions	Points	CO	BL	PI
1(a)	Discuss sub cooling of liquid refrigerant by using vapour refrigerant in liquid vapour regenerative heat exchanger.	5	1	1	1.4.1
1(b)	Explain in brief the desirable properties of ideal refrigerants.	5	3	2	1.4.1
1(C)	Need of aircraft air refrigeration.	5	2	3	1.4.2
1(d)	Define (i) dry bulb temperature (ii) wet bulb temperature (iii) specific humidity (iv) relative humidity (v) degree of saturation	5	3	2	1.4.1
2(a)	Explain actual vapour compression cycle with the help of p-h and T-s diagram and explain all the pressure drops and heat gains occurring in the actual cycle.	8	1	1	1.4.1
(b)	An ammonia ice plant operates between condenser temperature of 35°C and an evaporator temperature of -15°C. It produces 10 tonnes of ice per day from water at 30°C to ice at 0°C. Assuming simple saturation cycle and by using p-h chart for ammonia find followings. (i) The refrigeration capacity of the plant (ii) The mass flow rate of refrigerant (iii) Compressor discharge temperature. (iv) Coefficient of performance of the cycle.	12	2	3	2.2.2
3(a)	Explain regenerative system of aircraft refrigeration with schematic and T-s diagram.	08	1	1	1.3.1
(b)	For a boot strap air refrigeration system for an aircraft flying at an altitude of 2000 m. The ram air temperature and pressure are 17°C and 1.08 bar respectively. The ambient conditions being 80 kPa and 0°C. At the end of isentropic compression the air is at 4 bar and is cooled to 27°C using ram air. At this temperature, air is	12	2	3	2.2.2

	further cooled in auxiliary compressor driven by cooling turbine; the air is then cooled in an auxiliary heat exchanger to 27°C and finally expanded to cabin pressure of 1.01325 bar. Find the maximum pressure in the system, if air leaves the cabin at 25°C.				
4(a)	Explain complete designation system of all types of refrigerants.	10	3	2	1.3.1
(b)	The DBT and WBT of the air are 35°C and 23°C respectively. Find the followings if total air pressure is 1.01325 bar. Calculate following without using psychrometric chart. (i) Specific humidity (ii) Relative humidity (iii) DPT (iv) density (iv) Enthalpy.	10	3	2	2.1.2
5	A building has the following calculated cooling loads: Room sensible heat gain = 310 kW Room latent heat gain = 100 kW The space is maintained at DBT of 25°C and relative humidity of 50 %. The outdoor air is at 38°C and 50% R.H. And 10 % by mass of air supplied to the building is outdoor air. If the air supplied to the space is not at temperature lower than 18°C. Find (i) Minimum amount of air supplied to space in m^3/s. (ii) Volume flow rates of return air and outdoor air (iii) State and volume flow rate of air entering the cooling coil. (iv) Capacity, ADP, BPF and SHF of the cooling coil.	20	4	4	2.4.1
6(b)	Define the term "Effective Temperature" and explain its importance in air conditioning system. Describe factors which affect effective temperature.	10	3	2	1.3.1
(b)	Explain Electrolux refrigerator with neat sketch.	10	3	2	1.4.1
7(a)	Explain the mechanism of body heat loss and how it is related to human comfort. Also draw and explain comfort chart.	10	3	2	1.3.1
(b)	Explain various types of duct design methods.	10	3	2	1.3.1

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Previous ~~End~~ Sem Exam (KT)

Dec 2019

Max. Marks: **100** Duration: **3 hrs**

Class: **T. Y. Tech. Semester: VI** Program: **Mech Engg**

Name of the Course: **Internal combustion Engine** Course Code: **BTM 604**

Instructions:

- **Question No. 1 is compulsory.**
- Attempt **any Four questions** out of remaining six questions.
- Answers to all sub questions should be grouped together.
- All questions carry equal marks.
- Make suitable assumptions with proper explanations.

Q. No.		Marks	CO No.	M No
Q. 1	**Answer the following questions (any Four)**	20	1 - 3	1-6
a)	Compare SI and CI engines with respect to compression ratio, efficiency, weight, introduction of fuel.			
b)	Do I C Engines operate on a thermodynamic cycle? Draw the Otto cycle on p-V and T-s diagrams mark the various processes.			
c)	How does exhaust temperature and mean effective pressure affect the engine performance? Explain.			
d)	List three principal factors that influence engine performance? What is meant by the optimum spark advance?			
e)	Describe and explain the essential parts of a modern carburetor.			
f)	Explain the details of firing order. Why spark advance is required? Explain.			
Q. 2 (A)	A simple jet carburetor is required to supply 6 kg of air per minute and 0.45 kg of fuel per minute of density 740 kg/m^3. The air is initially at 1.013 bar and 27°C a) Calculate the throat diameter of the choke for flow velocity of 92 m/s. Velocity coefficient = 0.8. b) If the pressure drop across the fuel metering orifice is 0.75 of that at the choke, calculate the orifice diameter assuming $C_d = 0.60$.	10	3	2
(B)	Describe a battery ignition system with the help of sketch. What are the main disadvantages of a battery ignition system?	10	2, 3	2
Q. 3 (A)	A three liter 4-stroke diesel engine develops 12 kW per m^3 of free air inducted per minute. The volumetric efficiency is 82% at 3600 rpm referred to atmospheric condition of 1bar and 27°C. A rotary compressor which is mechanically coupled to the engine is used to supercharge the engine. The pressure ratio and the isentropic efficiency of the compressor are 1.6 and 75% respectively. Calculate the percentage increase in brake power due to supercharging. Assume mechanical efficiency of the engine to be 85% and air intake to the cylinder to be at the pressure equal to delivery pressure from compressor and temperature equal to 5.7°C less than the delivery temperature of the compressor. Also assume that cylinder contains volume of charge equal to swept volume.	10	3	4

(B)	Explain the air pollution due to I C Engine. What do you mean by incomplete combustion?	05	2	5
(C)	Explain the reasons for looking for alternate fuels for I C engines. Compare LPG and petrol as fuel for S I engines.	**05**	2	5
Q. 4	What is the importance of lubrication in I C engines? State the importance of engine friction.	**05**	2	6
(A)				
(B)	Why cooling is necessary for I C Engines? State the applications, advantages and disadvantages of air cooling system.	**05**	2	6
(C)	What do you mean by pre-ignition? How can it be detected?	05	2	3
(D)	What do you mean by performance of I C engines? What is the purpose of Morse test?	05	2	4
Q. 5	What are the main components of a fuel injection system? Explain any two components briefly.	06	1	3
(A)				
(B)	The following observations were made during a trial of a 4-stroke, single cylinder gas engine: Bore = 18 cm, stroke = 24 cm, duration of travel = 30 min, speed = 9000 RPM, total number of explosion = 4450, net load on the brake wheel = 40 kg, effective diameter of brake wheel = 1 m, total gas used at NTP = 2.4 m^3, IMEP = 5 bar, C.V. of fuel at NTP = 43960 kJ/kg, air consumption = 36 m^3, pressure of air = 720 mm Hg, temperature of air = 17°C, density of air at NTP = 1.29 kg/m^3, temperature of exhaust gas = 350°C, room temperature = 17°C, C_p of dry exhaust gas = 1 kJ/kgK, specific heat of water = 4.18 kJ/kg K, cooling water circulated = 80 kg, rise in temperature of cooling water = 30°C. Draw up the heat balance sheet on kJ/min and percentage basis. Calculate indicated, and mechanical efficiencies. Take R = 287 J.kgK	**14**	3	4
Q. 6	A 6-cylinder, 4-stroke C I engine develops 220 kW at 1500 rpm with BSFC of 0.273 kg/kWh. Determine the size of the single hole injector nozzle if the injection	**10**	3	3
(A)	pressure is 160 bar and the pressure in the combustion chamber is 40 bar. The period of injection is 30° of crank angle. Take density of fuel as 860 kg/m^3 and orifice discharge coefficient = 0.9			
(B)	What are the factors that limit the compression ratio that can be used in petrol engines? Explain briefly the combustion phenomenon in C I engines. What is delay period in C I engines?	**10**	1	3
Q. 7	**Write short note on following (any Four)** **(A)** Mixture requirements at different loads and speeds **(B)** Causes and problems of exhaust emissions **(C)** Use and study of Heat balance sheet **(D)** Supercharging and Turbocharging **(E)** Advantages and disadvantages of two stroke engines	**20**	2	1-7

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Previous ~~End~~ **Sem Exam (KT)**
Dec 2019

Max. Marks: **100** Duration: **3 hrs**

Class: **T. Y. B. Tech. Semester: VI** Program: **Mech Engg**

Name of the Course: **Internal combustion Engine** Course Code: **PCC-BTM 604**

Instructions:

- **Question No. 1 is compulsory.**
- Attempt **any Four questions** out of remaining six questions.
- Answers to all sub questions should be grouped together.
- All questions carry equal marks.
- Make suitable assumptions with proper explanations.

Q. No.		Points	CO	BL	PI
Q. 1	**Answer the following questions (any Four)**	**20**	1 - 3	1-7	1.2.1
a)	How are I C Engines classified?				
b)	Compare SI and CI engines with respect to: basic cycle, compression ratio, ignition, fuel used, and introduction of fuel.				
c)	Explain Phenomenon of dissociation.				
d)	Describe the essential parts of a carburetor.				
e)	What are the main sources of pollutants from petrol engine? Discuss the adverse effects of emissions on human health.				
Q. 2 (A)	An experimental 4-Stroke gasoline engine of 1.7 litre capacity is to develop maximum power at 5000 rpm. The volumetric efficiency is 75% and the A/F ratio is 14:1. Two carburetors are to be fitted and it is expected that at maximum power the air speed at the choke is 100 m/s. The coefficient of discharge for the venturi is assumed to be 0.80 and that of main jet is 0.65. An allowance should be made for emulsion tube, the diameter of which can be taken as 1/3 of choke diameter. The gasoline surface is 6 mm below the choke at this engine condition. Calculate the sizes of a suitable choke and main jet. The sp. gr. of the gasoline is 0.75. Take atmospheric condition as 1 bar and 300 K.	**10**	3	2	2.1.1
(B)	What are the functional requirements of an injection system?	**05**	2	3	1.2.1
C)	What are the functional divisions of MPFI system?	**05**	3	3	1.2.1
Q. 3 (A)	During the test of a single cylinder, four stroke oil engine, the following results were obtained: Cylinder diameter = 200 mm, Stroke = 400 mm, Mean effective pressure = 6 bar, Torque = 407 Nm, Speed of the engine = 250 rpm, Fuel consumption =	**10**	3	3	2.2.2

	4 kg/hr, Calorific value of fuel = 43 MJ/kg, Cooling water flow rate = 4.5 kg/min, A/F ratio = 30:1, Rise in cooling water temperature = 45°C , Temperature of exhaust gases = 420°C, Room temperature = 20°C, Specific heat of exhaust gases = 1 kJ/kg.K. Specific heat of Water = 4.18 kJ/kg. Draw up the heat balance sheet on kW and percentage basis.				
(B)	What is a 2-stroke engine and how does it differ from a 4-stroke engine?	**10**	2	2	2.1.1
C)	Explain the two types of cooling systems and compare them.				
Q. 4 (A)	A 8 cylinder 4 stroke S I Engine of 9 cm bore and 8 cm stroke with a compression ratio of 7 is tested at 4500 rpm on a dynamometer which has 54 cm arm. During a 10 minutes test the dynamometer scale beam reading was 42 kg and the engine consumed 4.4 kg of gasoline having a calorific value of 44000 kJ/kg. Air 27°C and 1 bar was supplied to the carburetor at the rate of 6 kg/min. Find (1) the BP delivered, (2) BMEP, (3) BSFC, (4) brake sp. air consumption (5) brake thermal efficiency, (6) volumetric efficiency, (7) Air/Fuel ratio.	**10**	2	2	3.1.1
(B)	In what respects four stroke cycle C I engine differ from that of an S I engine.	**05**	2	3	2.1.1
C)	What are the different Geometrical and Thermodynamic parameters of I C engine? Explain at least two parameters in detail.				
Q. 5 (A)	A 6-cylinder, 4-stroke C I engine operates on A/F ratio = 20. The diameter and stroke of the cylinder are 100 mm and 140 mm respectively. The volumetric efficiency is 80%. The condition of air at the beginning of compression are 1 bar and 27°C. (i) Determine the maximum amount of fuel that can be injected in each cylinder per second. (ii) If the speed of the engine is 1500 rpm, injection pressure is 150 bar, air pressure during fuel injection is 40 bar and fuel injection is carried out for 20° crank angle, determine the diameter of the fuel orifice assuming only one orifice is used. Take density of fuel as 860 kg/m3 and coefficient of discharge for the injector C_f as 0.67	**05** **10**	4	5	3.1.1
(B)	Discuss the difference between theoretical and actual valve timing diagram of a 4-Stroke diesel engine. Compare the relative advantages and disadvantages of 4-Stroke and 2-Stroke cycle engines.	**10**	3	3	2.1.1
Q. 6 (A)	An air compressor is being run by the entire output of a supercharged 4-stroke cycle diesel engine. Air enters the compressor at 25°C and is passed on to a cooler where 1210 kJ per minute is rejected. The air leaves the cooler at 65°C and 1.75 bar. Part of this air flow is used to supercharge the engine which has a volumetric efficiency of 72% based on induction manifold condition of 65°C and 1.75 bar. The engine which has six cylinders of 100 mm bore and 110 mm stroke runs at 2000 rpm and delivers an output torque of 150 Nm. The mechanical efficiency of engine is 80%. Determine : (i) The indicated mean effective pressure of the engine; (ii) The air consumption rate of the engine; (iii) The air-flow into compressor in kg per min.	**10**	4	3	3.1.1

(B)	A 4-cylinder, 4-stroke C I engine develops 200 kW at 2000 rpm. Its BSFC is 0.25 kg/kWh. The injector pressure is 200 bar at the beginning of injection and 500 bar at the end of injection. The injection period is 20°of crank angle. The pressures inside the cylinder at the beginning and end of injection are 30 bar and 50 bar respectively. Take density of fuel as 850 kg/m^3 and coefficient of discharge for the injector C_f as 0.8. Assume effective pressure of injection is equal to average pressure difference over the period of injection. Find the diameter of the fuel injector.	**10**	4	4	3.1.1
Q. 7	**Write short note on following (any Four)** **(A)** Octane Number and Cetane Number **(B)** Application of various types of I C Engines **(C)** Battery ignition system **(D)** Factors that limit the compression ratio in SI and CI engines **(E)** Importance of lubrication in IC engines	**20**	2	1-7	1.3.1

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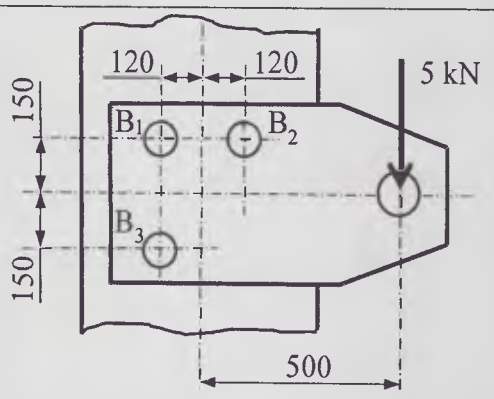
PREVIOUS SEMESTER EXAMINATION – DECEMBER 2019

Program: B.Tech. in Mechanical Engg.
Course Code: PCC-BTM602, BTM602
Course Name: Machine Design - I

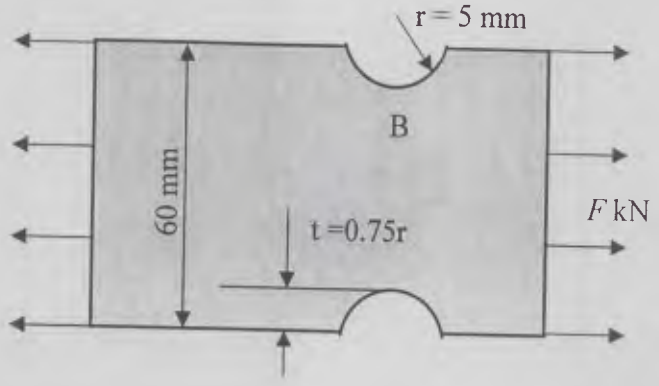
Duration: 3 Hours
Maximum Points: 100
Semester: VI

Notes:
1. Attempt **any five** questions.
2. Use of Design Data Book is permitted. Assume suitable data if necessary.

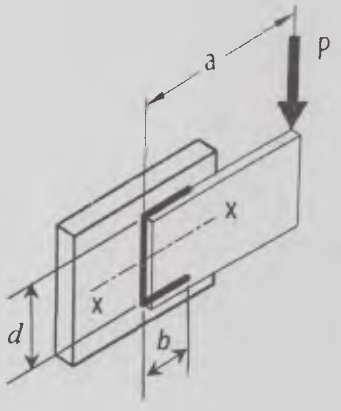
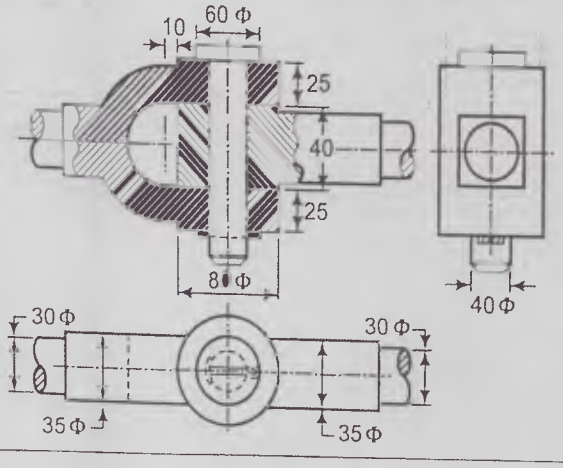
Q. No.	Questions	Points	CO	BL	PI
Q1	A) Describe the importance of ergonomic considerations in machine design with illustrative examples. How ergonomic features differ from the aesthetic considerations?	(5)	3	2	2.2.2
	B) The stress analysis results for a critical machine component indicate following state of stress at a location: $\sigma_x = 100$ MPa, $\sigma_y = 200$ MPa and $\tau_{xy} = 50$ MPa. Calculate factor of safety by maximum shear stress theory if yield strength of material is 500 MPa.	(5)	1	3	2.4.1
	C) Discuss with suitable examples, the manufacturing considerations in design of castings, welded parts and forged components.	(5)	3	2	2.2.2
	D) Describe the importance of Soderberg line and Goodman line in the design of machine components subjected to fluctuating loads.	(5)	1	2	2.1.2
Q2	A) A helical compression spring is required to deflect through approximately 10 mm when the external force on it varies from 200 to 400 N. The spring wire diameter is 6.5 mm and spring index is 8. The spring has square and ground ends. There should be gap of 0.5 mm between adjacent coils when the spring is subjected to maximum force of 400 N. The permissible shear stress is 50% of the material's ultimate tensile strength. Perform calculations to select suitable grade of unalloyed and cold drawn spring steel from the design handbook. Also calculate: (i) mean coil diameter, (ii) number of active coils, (iii) total number of coils, (iv) solid length and (v) free length.	(15)	2	4	2.4.1
	B) Compare advantages and disadvantages of bolted joints over welded joints. Give 3 examples of each type of joint typically used in industry.	(5)	2	3	3.2.3

Q3	A) A bracket is attached to a vertical pillar by means of 3 identical bolts B_1, B_2 and B_3 of size M10x1.5P. All dimensions are in mm. The bracket is subjected to an eccentric force of 5 kN as shown. Determine the total stress induced in bolt B_2.  B) A leaf spring consists of 2 extra full-length leaves and 8 graduated length leaves, including the master leaf. Each leaf is 6 mm thick and 50 mm wide. The center to center distance between two eyes is 1.0 m. The leaves are pre-stressed in such a way that when the load is maximum, stress induced in each leaf is same and equal to 350 MPa. Determine: (i) the maximum force that the spring can withstand, (ii) initial nip, (iii) initial pre-load required to close the gap.	**(10)** **(10)**	*2* *2*	*4* *3*	*2.4.1* *2.1.3*
Q4	A) Design screw and nut for a screw jack with load capacity of 10 kN and maximum lifting height of 800 mm. Do not design lifting collar/handle and support frame. Perform only single design iteration. Freehand draw assembly of the screw jack. B) List different types of keys along with their typical applications. Derive expressions to calculate stresses in parallel keys for a shaft of specified diameter and subjected to torsional loads.	**(15)** **(5)**	*4* *2*	*5* *3*	*3.4.1* *2.1.3*
Q5	A) It is required to select a standard "HIGH-SPEED" belting to drive a stamp-press running at 500 rpm. The stamp-press is driven by 18 kW, 1200 rpm motor. Space available for centre distance is 4 meters. The belt is open type. Select suitable belt and determine its length. B) Design a bushed pin type flexible coupling to connect the output shaft of 4-cylinder petrol engine to shaft of pulveriser. The engine delivers 20 kW power at 1400 rpm.	**(10)** **(10)**	*2* *2*	*4* *3*	*2.4.1* *2.1.3*
Q6	A) The shaft for driving a conveyor system in a factory for movement of finished delicate instruments is required to transmit 1 kW power at 300 rpm. The shaft is subjected to maximum bending moment of 100 N-m. Shaft material is 30C8 or equivalent. Recommend suitable diameter for the shaft using ASME method. Also select standard parallel key for the shaft. B) A rectangular plate, 10 mm thick, made of normalized steel of UTS = 600 MPa and in machined condition is shown in figure.	**(10)** **(10)**	*2* *1*	*3* *3*	*2.1.3* *2.1.3*

Calculate the maximum permissible amplitude of fully reversed fluctuating load F for a life of 20,000 cycles for the plate and with 90% reliability.



Briefly explain how you will perform the calculations if the load F is not fully reversed

Q7	A) A flat plate is attached to a support structure using fillet weld as shown in the figure. The load acting on plate P is 0.8 kN. Consider a = 500 mm, d = 100 mm and b = 80 mm. Determine size of the weld if the allowable shear stress is limited to 100 MPa. 	**(10)**	*2*	*3*	*2.1.3*
	B) A knuckle joint designed to carry axial tensile static load of 25 kN is shown in figure. All parts are made of carbon steel 30C8 or equivalent. Calculate factor of safety for the fork and pin against different modes of failure. If the axial load is fluctuating instead of static, will there be any change in design procedure? Briefly comment 	**(10)**	*1*	*3*	*2.1.3*

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Course Code: PCC-BTM602, BTM602
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Duration: 3 Hours
Maximum Points: 100
Semester: VI

Notes:
1. Attempt **any five** questions.
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Q. No.	Questions	Points	CO	BL	PI
Q1	A) Describe the importance of ergonomic considerations in machine design with illustrative examples. How ergonomic features differ from the aesthetic considerations?	(5)	3	2	2.2.2
	B) The stress analysis results for a critical machine component indicate following state of stress at a location: $\sigma_x = 100$ MPa, $\sigma_y = 200$ MPa and $\tau_{xy} = 50$ MPa. Calculate factor of safety by maximum shear stress theory if yield strength of material is 500 MPa.	(5)	1	3	2.4.1
	C) Discuss with suitable examples, the manufacturing considerations in design of castings, welded parts and forged components.	(5)	3	2	2.2.2
	D) Describe the importance of Soderberg line and Goodman line in the design of machine components subjected to fluctuating loads.	(5)	1	2	2.1.2
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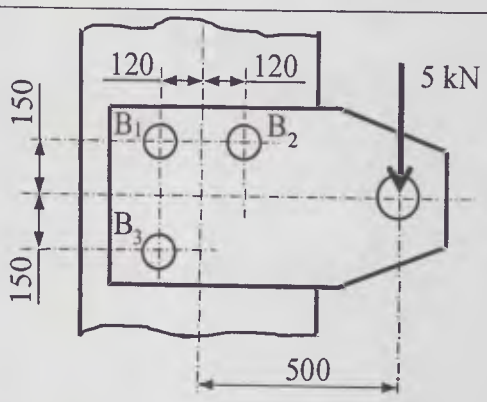
	B) Compare advantages and disadvantages of bolted joints over welded joints. Give 3 examples of each type of joint typically used in industry.	(5)	2	3	3.2.3

Q3	A) A bracket is attached to a vertical pillar by means of 3 identical bolts B_1, B_2 and B_3 of size M10x1.5P. All dimensions are in mm. The bracket is subjected to an eccentric force of 5 kN as shown. Determine the total stress induced in bolt B_2.  B) A leaf spring consists of 2 extra full-length leaves and 8 graduated length leaves, including the master leaf. Each leaf is 6 mm thick and 50 mm wide. The center to center distance between two eyes is 1.0 m. The leaves are pre-stressed in such a way that when the load is maximum, stress induced in each leaf is same and equal to 350 MPa. Determine: (i) the maximum force that the spring can withstand, (ii) initial nip, (iii) initial pre-load required to close the gap.	**(10)** **(10)**	*2* *2*	*4* *3*	*2.4.1* *2.1.3*
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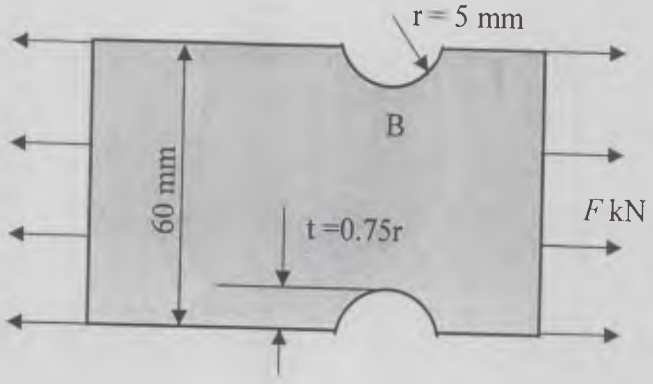
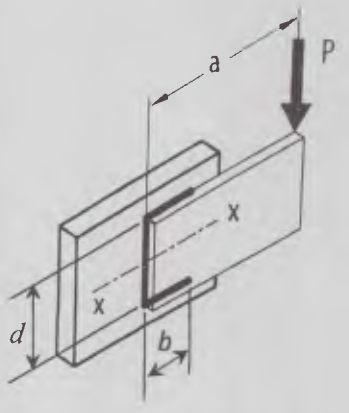
Q6	A) The shaft for driving a conveyor system in a factory for movement of finished delicate instruments is required to transmit 1 kW power at 300 rpm. The shaft is subjected to maximum bending moment of 100 N-m. Shaft material is 30C8 or equivalent. Recommend suitable diameter for the shaft using ASME method. Also select standard parallel key for the shaft. B) A rectangular plate, 10 mm thick, made of normalized steel of UTS = 600 MPa and in machined condition is shown in figure.	**(10)** **(10)**	*2* *1*	*3* *3*	*2.1.3* *2.1.3*

Calculate the maximum permissible amplitude of fully reversed fluctuating load F for a life of 20,000 cycles for the plate and with 90% reliability.



Briefly explain how you will perform the calculations if the load F is not fully reversed

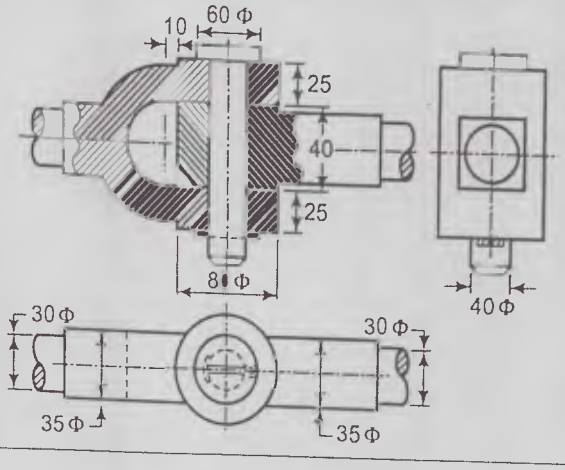
Q7 A) A flat plate is attached to a support structure using fillet weld as shown in the figure. The load acting on plate P is 0.8 kN. Consider a = 500 mm, d = 100 mm and b = 80 mm. Determine size of the weld if the allowable shear stress is limited to 100 MPa.



(10) | *2* | *3* | *2.1.3*

B) A knuckle joint designed to carry axial tensile static load of 25 kN is shown in figure. All parts are made of carbon steel 30C8 or equivalent. Calculate factor of safety for the fork and pin against different modes of failure.

If the axial load is fluctuating instead of static, will there be any change in design procedure? Briefly comment



(10) | *1* | *3* | *2.1.3*